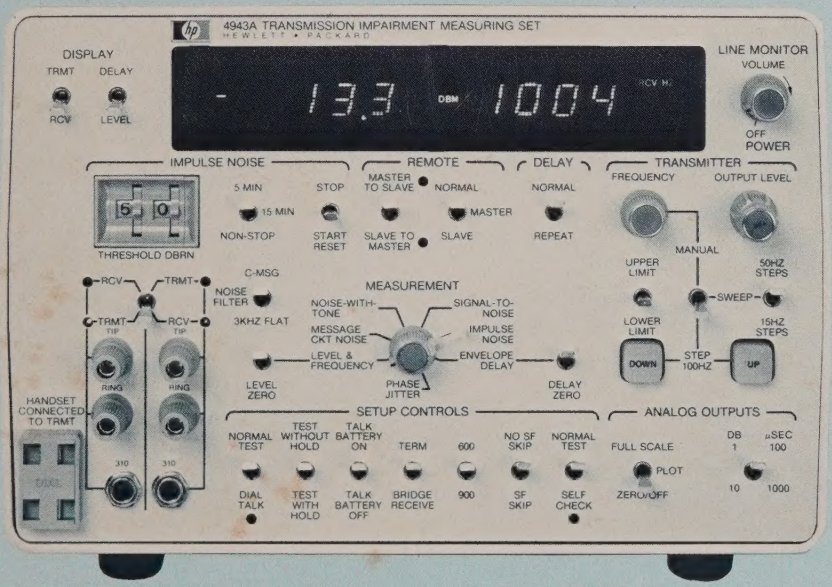
HEWLETT hp PACKARD

Model 4943A

Transmission Impairment Measuring Set



Operating Instructions

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

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OPERATING INSTRUCTIONS

TRANSMISSION IMPAIRMENT MEASURING SET

Model 4943A
All Serial Numbers

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690 E. Middlefield Road, Drawer 7021, Mountain View, CA. 94042 U.S.A.

04943-90001

PRINTED: OCTOBER 1977

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INTRODUCTION

This booklet contains quick reference instructions for operating the Hewlett-Packard Model 4943A Transmission Impairment Measuring Set (TIMS). For more detailed operating instructions, description, and service information, refer to the Operating & Service Manual (HP Part No. 04943-90002).

Operating instructions are organized in three parts within this manual. General Information and Procedures are contained in sections on white pages; Instructions for NORMAL, or manual, operation are contained in sections on blue pages; Instructions for MASTER/SLAVE, or remote, operation are contained in sections on yellow pages.

The Model 4943A can also be operated under calculator or computer control and acquisition when equipped with Option 010 Hewlett-Packard Interface Bus (HP-IB). Instructions for programming and operating HP-IB are contained in the 4943A Operating & Service Manual.

GENERAL DESCRIPTION

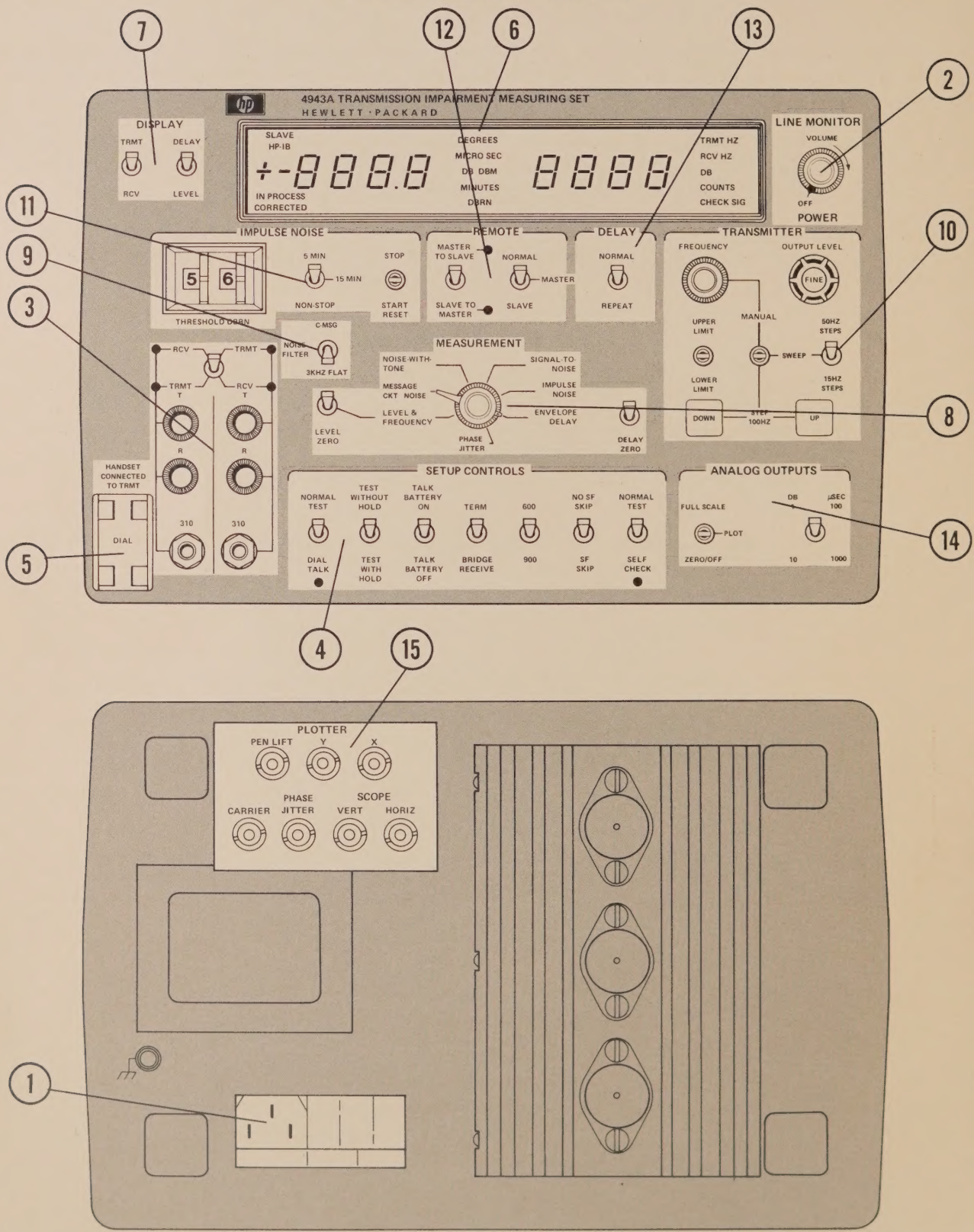
The 4943A measures all of the basic parameters necessary to characterize a voice channel for its ability to transmit data traffic, as defined by Bell System Technical Reference PUB 41009, dated May 1975. Measurements can be made manually end-to-end with a 4943A at each end of the circuit; manually looped-back with a 4943A at one end of the circuit; or remotely from one end with a MASTER operated 4943A controlling a SLAVE operated 4943A with all measurements displayed on the MASTER unit. The 4943A can be operated with other test sets with compatible measurements and capabilities.

All measurements are displayed on digital readouts. Two separate readouts allow simultaneous display of up to two different parameters. The displays can be selected to show either transmitted or received information. Measurement unit annunciators beside each readout automatically show the operator the measurement displayed. Ranging, decimal placement, and polarity are all completely automatic.

IDENTIFICATION

Each unit is identified by a distinctive serial number and option number (if applicable) engraved on a plate on the rear of the test set. Please refer to this identification when corresponding with Hewlett-Packard regarding servicing and operating matters.

DESCRIPTION OF CONTROLS, CONNECTORS, AND INDICATORS



DESCRIPTION OF CONTROLS, CONNECTORS, AND INDICATORS

(1) **Power Cord Module.** Accepts power cord supplied with instrument. Contains line fuse and PC board for selecting line voltage (see Section II of the 4943A Operating and Service Manual). WARNING: ALWAYS CONNECT POWER CORD TO A PROPERLY GROUNDED 3-WIRE POWER OUTLET.

(2) **LINE MONITOR Volume/POWER Off Control.** Switches instrument ac operating power ON and OFF and controls volume of LINE MONITOR speaker. The DISPLAY TRMT – RCV switch determines whether the transmitted or received signal is being monitored. The speaker is located on the right-hand side panel.

(3) **RCV-TRMT Jacks.** A two position toggle switch is used to reverse connections of the left and right jack fields. When switch is in up position, the left jacks are connected for RCV (receive) and the right jacks for TRMT (transmit). When switch is down, connections are reversed. Dot lamps indicate functions of respective jack fields. Connections can be made either to the 310 jacks, or to the TIP and RING binding posts, which are multipled.

(4) **SETUP CONTROLS.**

NORMAL TEST – DIAL/TALK Switch. In NORMAL TEST position the selected TRMT jack is connected to the test set's transmitter circuitry, but not to the DIAL connectors. In DIAL/TALK position the TRMT jack is connected to the DIAL connectors, but not to the transmitter circuitry.

TEST WITHOUT HOLD – TEST WITH HOLD Switch. In TEST WITHOUT HOLD position the test set holding circuits are disconnected from the RCV-TRMT jacks. In TEST WITH HOLD position the holding circuits are connected across TIP and RING of both jack fields to hold 2-wire wet (DDD) circuits while testing.

TALK BATTERY ON – TALK BATTERY OFF Switch. In TALK BATTERY ON position the test set provides the necessary talk battery to the DIAL terminals to talk on dry circuits with a lineman's handset. In TALK BATTERY OFF position, talk battery must be supplied by the circuit under test if talking is desired.

TERM – BRIDGE RECEIVE Switch. In TERM position the test set provides a termination on both the RCV AND TRMT circuits. The desired terminating impedance must be selected with the 600-900 switch. In BRIDGE-RECEIVE position the receiving test set is bridged across the circuit under test, which must be terminated with other equipment. NOTE: When using BRIDGE RECEIVE it is still necessary to select the proper impedance of the line under test with the 600-900 switch in order to normalize the measurements.

600-900 Switch. The 600 Ω or 900Ω termination must be selected to match the characteristic impedance of the line under test. When operating in TERM mode, both the TRMT and RCV circuits are terminated in the selected impedance. When operating in BRIDGE RECEIVE mode, the TRMT circuit is still terminated in the selected impedance and the RCV circuit is bridged by more than 45 kΩ. The selection also normalizes level measurements for the respective impedances.

(continued on next page)

NO SF SKIP – SF SKIP Switch. In NO SF SKIP position the test set will transmit all selected frequencies. In SF SKIP position the test set will not transmit any frequencies between 2450 Hz and 2750 Hz. This feature prevents the circuit under test from being disconnected by SF signaling units on the dial-up network.

NORMAL TEST – SELF CHECK Switch. In NORMAL TEST position the test set performs normal testing. In SELF CHECK position proper operation of the test set can be verified by performing the procedures given in the SELF CHECK section of this manual.

(5) **DIAL Connectors.** Provides connections for a lineman's handset (butt-in). The terminals are connected to the selected TRMT jack when the DIAL/TALK mode is selected.

(6) **Digital Displays.** Two digital displays provide quantitative information and measurement units for all measurements. Ranging is automatic, and polarity and decimal points are automatically displayed when appropriate. Up to two parameters can be displayed simultaneously. The displays also indicate underrange and overrange conditions. Display of only a (–) sign indicates underrange. Display of only a (+) sign indicates overrange.

(7) **DISPLAY Switches.**

TRMT – RCV Switch. Selects either the transmitted or received information to be displayed.

LEVEL – DELAY Switch. Used in ENVELOPE DELAY measurements to display either level (DBM) or delay (MICRO SEC) information.

(8) **MEASUREMENT Switch.** Programs the test set to perform the selected measurement. For a detailed procedure describing the use of each MEASUREMENT switch position, see the appropriate section of this manual.

LEVEL ZERO Switch. Used in LEVEL & FREQUENCY mode to establish a zero dB reference. All subsequent measurements will be made in dB relative to this reference. If this switch is not operated, measurements will be in absolute dBm. NOTE: If LEVEL ZERO switch has been actuated and it is desired to make an absolute dBm measurement, momentarily rotate MEASUREMENT switch to another position, then back to LEVEL & FREQUENCY again.

DELAY ZERO Switch. Used in ENVELOPE DELAY mode to establish a zero microsecond delay reference. All subsequent envelope delay measurements will be relative to this reference.

(9) **NOISE FILTER Switch.** Used in NOISE measurements to select desired weighting filter (C-MSG or 3KHZ FLAT).

(10) **TRANSMITTER Controls.**

MANUAL – SWEEP – STEP 100 HZ Switch. In MANUAL position frequency is continuously variable from 200 Hz to 3950 Hz by adjusting FREQUENCY control. In SWEEP position frequency automatically steps up and down in 50 Hz or 15 Hz steps selected by 50 HZ STEPS – 15 HZ STEPS switch. Upper and lower sweep limits are set by tuning to desired frequency in MANUAL or STEP 100 HZ and momentarily activating UPPER LIMIT – LOWER LIMIT switch.

OUTPUT LEVEL Control. Varies transmitter output level continuously from –39 dBm to +10 dBm. Output level is displayed on left display.

(11) **IMPULSE NOISE Controls.**

THRESHOLD DBRN Switches. Sets the desired threshold above which impulse noise peaks will be totalized on the display. The threshold is adjustable from 30 to 109 dBrn.

5 MIN – 15 MIN – NONSTOP Count Time Switch. Selects length of time for which impulse noise is counted. Counting is stopped automatically when either the 5 MIN or 15 MIN positions are selected. Counting must be stopped manually with the STOP – START/RESET switch when the NONSTOP position is selected.

STOP – START/RESET Switch. Impulse noise counting is stopped and total is held on display when switch is momentarily held in STOP position. All previous counts are reset to zero on display and new counting interval is initiated when switch is momentarily held in START/RESET position.

(12) **REMOTE Switches.**

MASTER TO SLAVE – SLAVE TO MASTER Switch. Selects transmission path to be tested. Selecting the MASTER TO SLAVE position will cause the circuit connected to the TRMT jack at the MASTER unit to be tested. Selecting the SLAVE TO MASTER position will cause the circuit connected to the RCV jack at the MASTER unit to be tested. The dot lamp associated with the respective position indicates that the MASTER unit has achieved control of the SLAVE unit. The lamp should light within 10 seconds after the NORMAL – MASTER – SLAVE switches are properly positioned on both the MASTER and SLAVE units.

NORMAL – MASTER – SLAVE Switch. In NORMAL position all controls are under manual front panel control. The test set can be operated manually with other compatible test sets. In MASTER position the unit is in remote control of the SLAVE unit for all MEASUREMENT functions. In SLAVE position the unit is remotely controlled by the MASTER unit for all MEASUREMENT functions.

(13) **DELAY Switch.** Used in ENVELOPE DELAY mode to determine whether the test set is to measure envelope delay (NORM), or to retransmit the envelope delay signal from the far-end of the circuit (REPEAT). This control is not used during MASTER-SLAVE operation.

(14) **ANALOG OUTPUTS Controls.**

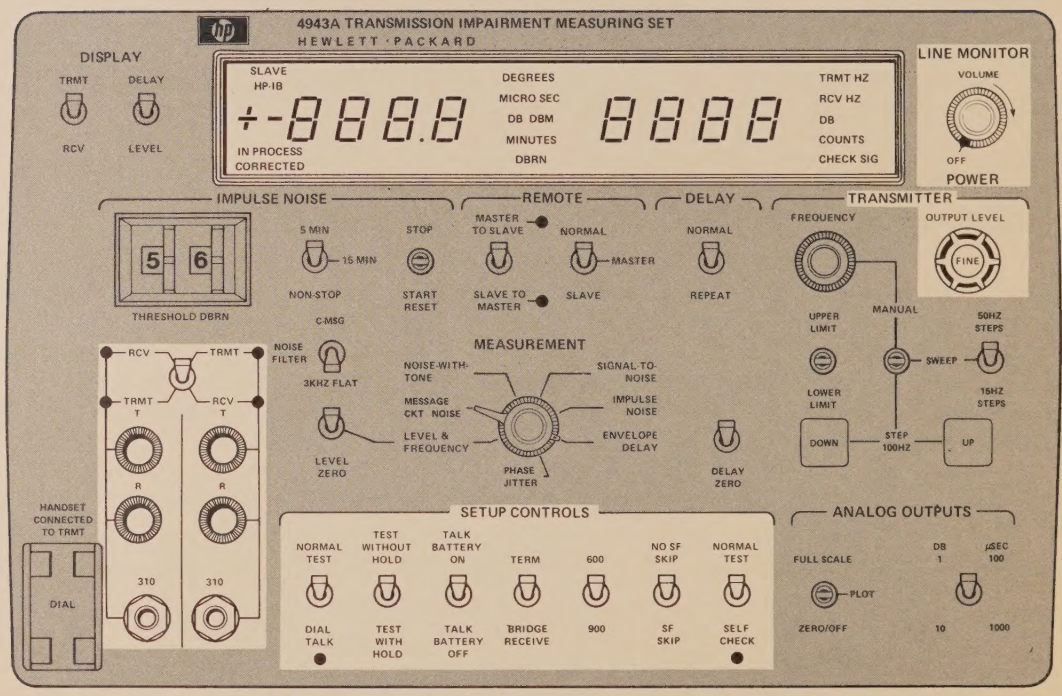
FULL SCALE – PLOT – ZERO/OFF Switch. In FULL SCALE position, full scale voltage (+10V) is applied to X and Y output jacks for use in calibrating upper right corner of X-Y Recorder plot. In PLOT position, voltages proportional to frequency or time and measured signal are sent to X and Y output jacks respectively. In ZERO/OFF position 0 volts is applied to both X and Y outputs for use in calibrating lower left corner of X-Y Recorder plot or for deactivating analog output signals.

DB USEC Switch. Selects sensitivity for Y Axis scale. In upper position each internally generated graticule line represents 1 dB in LEVEL & FREQUENCY and 100 uS in ENVELOPE DELAY. In lower position, each graticule line represents 10 dB and 1000 uS respectively.

(15) **ANALOG OUTPUT Connectors.** Used to connect analog output circuitry to an oscilloscope or strip chart recorder. Refer to 4943A Operating and Service Manual for complete description and connection instructions.

(15) **Option 010 only:** Due to rear panel space restrictions, the BNC connectors are replaced by a 14-pin connector for Analog Outputs, in addition to the added 24-pin connector for Hewlett-Packard Interface Bus (HP-IB).

SETUP AND TURN ON



SETUP AND TURN ON

1. Referring to Section II of the 4943A Operating and Service Manual, verify that instrument is set for line voltage to be used (100V, 120V, 220V or 240V) and that proper fuse is installed (0.75A normal blow for 100V and 120V; 0.375A normal blow for 220V and 240V).
2. Connect power cord to rear panel power receptacle and to a PROPERLY GROUNDED 3-WIRE POWER OUTLET.
3. Rotate POWER Off control clockwise past detent position to apply power to test set.
4. Set SETUP CONTROLS switch to BRIDGE RECEIVE if test set is to be bridged across receive line. Set to TERM if test set is to be used as termination on receive line.
5. Set SETUP CONTROLS switch to 600 or 900 to match impedance of lines under test.
6. Set SETUP CONTROLS switch to SF SKIP if transmitting over a dial-up network and single frequency (SF) signaling units are on the network.
7. Set SETUP CONTROLS switch to NORMAL TEST. Refer to SELF CHECK procedure if desired to verify test set performance.

NOTE

The SELF CHECK procedure should be performed periodically to verify performance of the test set. SELF CHECK is recommended before transporting the test set to a remote testing site; or whenever there is any doubt about transmission measurement results.

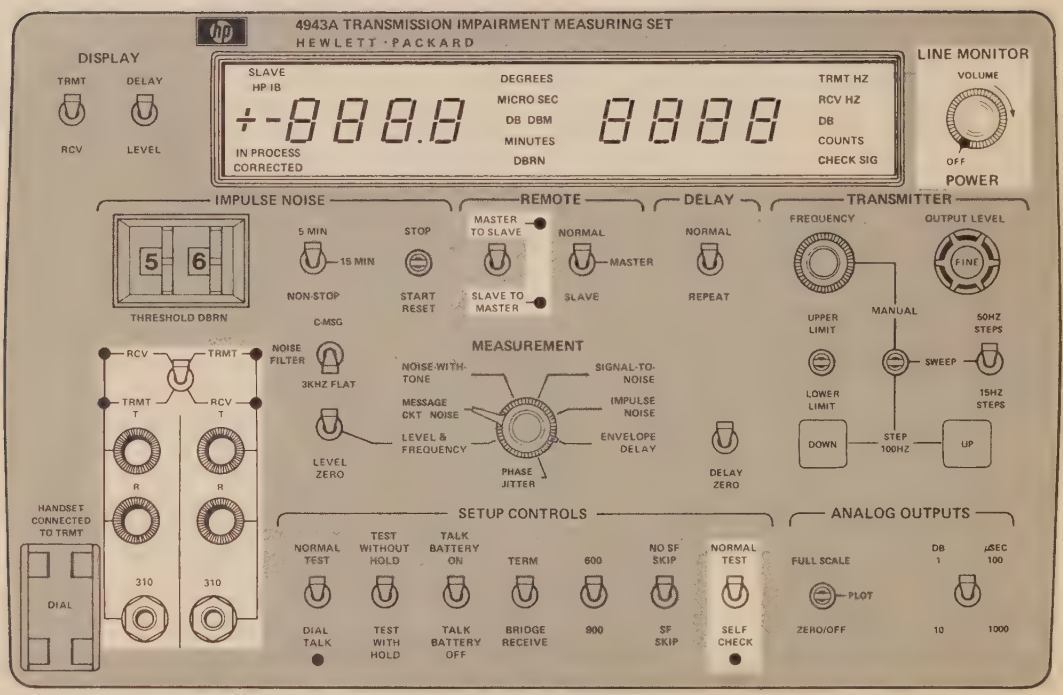
8. Set SETUP CONTROLS switch to TEST WITHOUT HOLD.
9. Turn OUTPUT LEVEL control full counterclockwise.
10. Position RCV-TRMT jacks switch to select the receive or transmit function for the left jack field. Connect transmit and receive lines (if both are required) to the appropriate jacks. Refer to DIAL, TALK, LISTEN, & HOLD procedures if dialing, talking, listening, or holding is desired on the lines under test.

NOTE

A 4-wire circuit is required to operate in the remote MASTER-SLAVE mode. If desired to test a 2-wire circuit in the remote MASTER-SLAVE mode, a second 2-wire circuit must be provided.

11. If X-Y Recorder plots or CRT presentation are desired, refer to ANALOG OUTPUTS section.
12. If remote MASTER-SLAVE operation is desired, refer to SLAVE SETUP or MASTER OPERATION procedures.
13. Select desired MEASUREMENT mode and refer to appropriate measurement procedure.

SELF-CHECK


4943A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT · PACKARD
DISPLAY
TRMT
DELAY
RCV
LEVEL
SLAVE
HP IB
IN PROCESS
CORRECTED
DEGREES
MICRO SEC
DB DBM
MINUTES
DBRN
TRMT HZ
RCV HZ
DB
COUNTS
CHECK SIG
LINE MONITOR
VOLUME
OFF
POWER
IMPULSE NOISE
THRESHOLD DBRN
5 MIN
15 MIN
NON-STOP
STOP
START
RESET
C-MSG
REMOTE
MASTER TO SLAVE
SLAVE TO MASTER
NORMAL
MASTER
SLAVE
DELAY
NORMAL
REPEAT
TRANSMITTER
FREQUENCY
OUTPUT LEVEL
FINE
MANUAL
UPPER LIMIT
LOWER LIMIT
SWEEP
50HZ STEPS
15HZ STEPS
DOWN
STEP 100HZ
UP
RCV
TRMT
TRMT T
RCV T
R
310
NOISE FILTER
3KHZ FLAT
LEVEL ZERO
MEASUREMENT
NOISE-WITH-TONE
SIGNAL-TO-NOISE
MESSAGE CKT NOISE
IMPULSE NOISE
LEVEL & FREQUENCY
ENVELOPE DELAY
PHASE JITTER
DELAY ZERO
HANDSET CONNECTED TO TRMT
DIAL
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
DIAL TALK
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
SELF CHECK
ANALOG OUTPUTS
FULL SCALE
PLOT
ZERO/OFF
DB
1
10
µSEC
100
1000

SELF-CHECK

NOTE

The SELF CHECK routine automatically makes an operational check of the test set, including its ability to operate in MASTER and SLAVE modes. The test set will automatically step through the SELF CHECK routine and should produce indications at each step as indicated below. At the end of the SELF CHECK routine, the display will indicate PASS if all checks are within specifications. If any steps fail to pass, the display will indicate failure codes at the end of the routine for those steps that fail to pass. A list of SELF CHECK failure codes, and their meanings are given at the end of this procedure.

The SELF CHECK procedure should be performed periodically to verify performance of the test set. SELF CHECK is recommended before transporting the test set to a remote testing site; or whenever there is any doubt about transmission measurement results.

1. PRELIMINARY SETUP

   a. Disconnect test set from on-line testing.

   b. Switch POWER ON.

   c. Loop TRMT jack to RCV jack. Operate RCV/TRMT jack field switch and observe that corresponding dot lamps light.

   d. Set all SETUP CONTROLS Switches to "up" positions.

   e. Set NORMAL TEST – SELF CHECK Switch to SELF CHECK.

2. STEP 1: DISPLAY AND ANNUNCIATOR CHECKS

   a. Observe that left display indicates +888.8 and that right display indicates 8888. Observe that all numerical segments are present and evenly illuminated.

   b. Observe that all display annunciators (except the minus sign) are on and evenly illuminated.

   c. Observe that MASTER TO SLAVE and SLAVE TO MASTER dot lights are on.

NOTE

It is not necessary to observe the following test routine unless it is desired to analyze a specific problem with the test set. SELF CHECK status will be displayed at the end of the routine.

3. STEPS 2-4: LEVEL & FREQUENCY CHECKS

   a. Left display should indicate +0.0 DBM (±0.3 dBm). Right display should indicate 1004 RCV HZ (±2 Hz).

   b. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 204 RCV HZ (±2 Hz).

   c. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 3904 RCV HZ (±2 Hz).

4. STEPS 5-7: C-MESSAGE FILTER CHECKS

   a. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 1004 RCV HZ (±2 Hz).

   b. Left display should indicate +16.0 DB (±1.0 dB). Right display should indicate 304 RCV HZ (±2 Hz).

   c. Left display should indicate +2.5 DB (±1.0 dB). Right display should indicate 3004 RCV HZ (±2 Hz).

(continued on next page)

5. STEPS 8-10: 3 KHZ FLAT FILTER CHECKS
   a. Left display should indicate +0.0 DB (±0.3 dB). Right display should indicate 1004 RCV HZ (±2 Hz).
   b. Left display should indicate +0.0 DB (±0.5 dB). Right display should indicate 304 RCV HZ (±2 Hz).
   c. Left display should indicate +3.0 DB (±2.0 dB). Right display should indicate 3004 RCV HZ (±2 Hz).
6. STEP 11: NOISE-WITH-TONE NOTCH CHECK
   a. Left display should indicate greater than +50 DBM. Right display should indicate 1004 RCV HZ (±2 Hz).
7. STEP 12: IMPULSE NOISE CHECK
   a. Right display should indicate 70 COUNTS (±4 Counts).
8. STEP 13: ENVELOPE DELAY CHECK
   a. Left display should reset to 0 MICROSECONDS, then indicate 3000 MICROSECONDS (±10μS). Right display should indicate 1804 RCV HZ (±2 Hz).
9. STEPS 14-15: PHASE JITTER CHECKS
   a. Left display should read +0.0 DEGREES (±0.2 Deg.). Right display should indicate 1004 RCV HZ (±2 Hz).
   b. Left display should read +11.5 DEGREES (±0.7 Deg.). Right display should indicate 1004 RCV HZ (±2 Hz).
10. STEP 16: SELF CHECK STATUS DISPLAY
   a. If all SELF CHECK tests are within specifications, the display will indicate PASS until the NORMAL TEST-SELF CHECK switch is returned to the NORMAL TEST position. The test set has passed, in addition to the above visible tests, an ENVELOPE DELAY response time test, an IMPULSE NOISE time base generator test, and a complete check of the modem used for MASTER-SLAVE operation.
   b. If the instrument fails to pass any of the above tests, failure codes will be displayed indicating the tests that have failed. These codes will be displayed sequentially until the NORMAL TEST-SELF CHECK switch is returned to the NORMAL TEST position. The table at right shows interpretations of the SELF CHECK failure codes that can be displayed.
11. SELF CHECK – MODEM ONLY.

If a quick SELF CHECK of only the modem is desired, the following procedure can be used:

   a. Perform PRELIMINARY SETUP procedures (a) through (d).
   b. Switch to SELF CHECK. Depress and hold DELAY ZERO Switch until left display indicates "PASS", then release.
   c. If modem passes SELF CHECK, display will immediately indicate PASS. Refer to failure codes, at right, if failure code is displayed.

SELF-CHECK FAILURE CODES

CODE	MESSAGE
H16	Test signal not looped around.
H20	Level out of tolerance at 204 Hz (STEP 3).
H21	Level out of tolerance at 1004 Hz (STEP 2).
H22	Level out of tolerance at 3904 Hz (STEP 4).
H30	C-Message Filter out of tolerance at 304 Hz (STEP 6).
H31	C-Message Filter out of tolerance at 1004 Hz (STEP 5).
H32	C-Message Filter out of tolerance at 3004 Hz (STEP 7).
H33	Noise-With-Tone notch filter out of tolerance (STEP 11).
H34	Impulse Noise counts out of tolerance (STEP 12).
H35	3KHZ FLAT Filter out of tolerance at 304 Hz (STEP 9).
H36	3KHZ FLAT Filter out of tolerance at 1004 Hz (STEP 8).
H37	3KHZ FLAT Filter out of tolerance at 3004 Hz (STEP 10).
H38	Impulse Noise time base generator out of tolerance (STEP 12).
H40	Frequency out of tolerance at 1004 Hz (STEP 2).
H41	Frequency out of tolerance at 204 Hz (STEP 3).
H42	Frequency out of tolerance at 3904 Hz (STEP 4).
H50	Residual Phase Jitter out of tolerance (STEP 14).
H51	Phase Jitter out of tolerance (STEP 15).
H70	Envelope Delay response time out of tolerance (STEP 13).
H71	Envelope Delay accuracy out of tolerance (STEP 13).
H72	Envelope Delay 83-1/3 modulation missing (STEP 13).
H80 H81 H82 H83 H84	Test set modem does not pass SELF CHECK (NOTE: Failure of the modem affects only MASTER – SLAVE operation. Normal operation is not affected.)

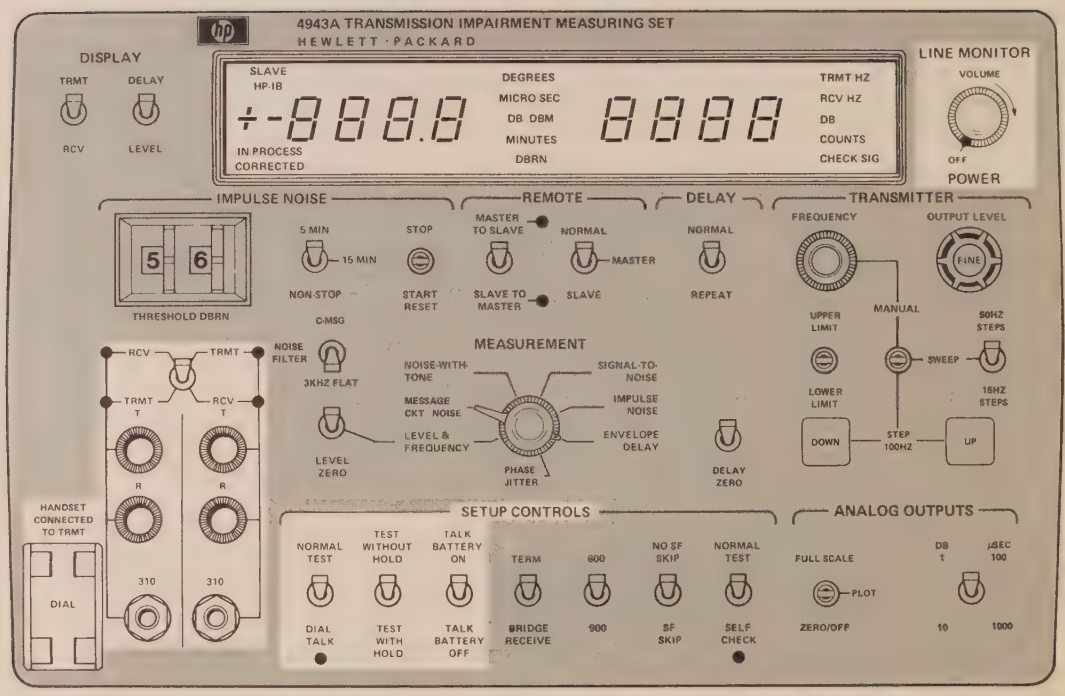
CONDITION CODES

Under certain conditions, the 4943A will abort or fail to achieve its normal display and indicate a "condition code" in the display. Following is a list of condition codes that can occur, their messages, probable causes, and recommended remedial actions to clear the condition. (Also refer to SELF CHECK procedure for listing of SELF CHECK failure codes).

CONDITION CODE	MESSAGE	PROBABLE CAUSES	RECOMMENDED ACTIONS
H-00	Front panel controls changed while MASTER attempting to achieve control over SLAVE.	1. Operator error.	1. Do not touch controls until dot light illuminates.
H-01	No data carrier received from SLAVE.	1. SLAVE OUTPUT LEVEL set too low	1. Check SLAVE OUTPUT LEVEL.
		2. Excessive circuit loss.	2. Check that MASTER receives at least –40 dBm.
		3. 4943A problem.	3. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.
H-02, H-11	No data information received from SLAVE.	1. Excessive noise on circuit.	1. Check circuit noise and impulse noise.
		2. 4943A problem.	2. Perform SELF CHECK on SLAVE unit. Return test set for repair if necessary.
H-03, H-04	Data errors.	1. Excessive noise on circuit.	1. Check circuit noise and impulse noise.
		2. 4943A problem.	2. Perform SELF CHECK on MASTER unit. Return test set for repair if necessary.
H-05	Inappropriate response to MASTER-SLAVE commands.	1. 4943A problem.	1. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.
		2. Distortion on circuit due to high level or circuit malfunction.	2. Check MASTER and SLAVE OUTPUT LEVELS.
H-06	SLAVE not responding to MASTER command.	1. MASTER OUTPUT LEVEL set too low.	1. Check MASTER OUTPUT LEVEL.
		2. Excessive circuit loss.	2. Check that SLAVE receives at least –40 dBm.
		3. Excessive noise on circuit.	3. Check circuit noise and impulse noise.
		4. 4943A problem.	4. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.

CONDITION CODE	MESSAGE	PROBABLE CAUSES	RECOMMENDED ACTIONS
H-07	Incompatible SLAVE measurement.	1. SLAVE is being requested to make a measurement it is not capable of making.	1. SLAVE must be compatible with MASTER (or it aborts to LINE LOOP BACK mode for measurements not available in SLAVE unit).
H-08	Invalid command.	1. 4943A problem.	1. Perform SELF CHECK on MASTER unit. Return test set for repair if necessary.
H-09	No data received when expected.	1. Circuit dropout. 2. SLAVE OUTPUT CONTROL moved during data transmission. 3. 4943A problem.	1. Check circuit; re-run test. 2. Do not touch SLAVE OUTPUT Control while measurement in progress. 3. Perform SELF CHECK on MASTER and SLAVE units. Return test set for repair if necessary.
H-10	SLAVE Underrange; test Level or Noise below range capability.	1. Receive LEVEL less than −70 dBm. 2. Receive NOISE less than +20 dBrn.	1. Normal condition; no action necessary.
H-11 See H-02			
H-12	IMPULSE NOISE	1. IMPULSE NOISE exceeded 9999 COUNTS.	1. User shorter counting interval.
H-13	MASTER lost control of SLAVE.	1. SLAVE REMOTE Switch changed to NORMAL or MASTER during data transmission.	1. Do not touch SLAVE REMOTE Switch while measurement in progress.
H-14	Signal dropout >1 Sec. during IMPULSE NOISE measurement.	1. Circuit dropped out carrier.	1. Initiate new test.
H-15	PHASE JITTER overrange.	1. PHASE JITTER greater than 40 DEGREES.	1. Normal condition; no action necessary.
H-16	Improper test signal.	1. Operator error.	1. Check for proper MEASUREMENT Switch position at sending test set.

DIAL, TALK, LISTEN, AND HOLD



DIAL, TALK, LISTEN, AND HOLD

1. Perform SETUP AND TURN ON procedure through step 9.
2. Connect lineman's handset (butt-in) to DIAL connectors.
3. Refer to table below for proper hookup and control settings.

NOTE

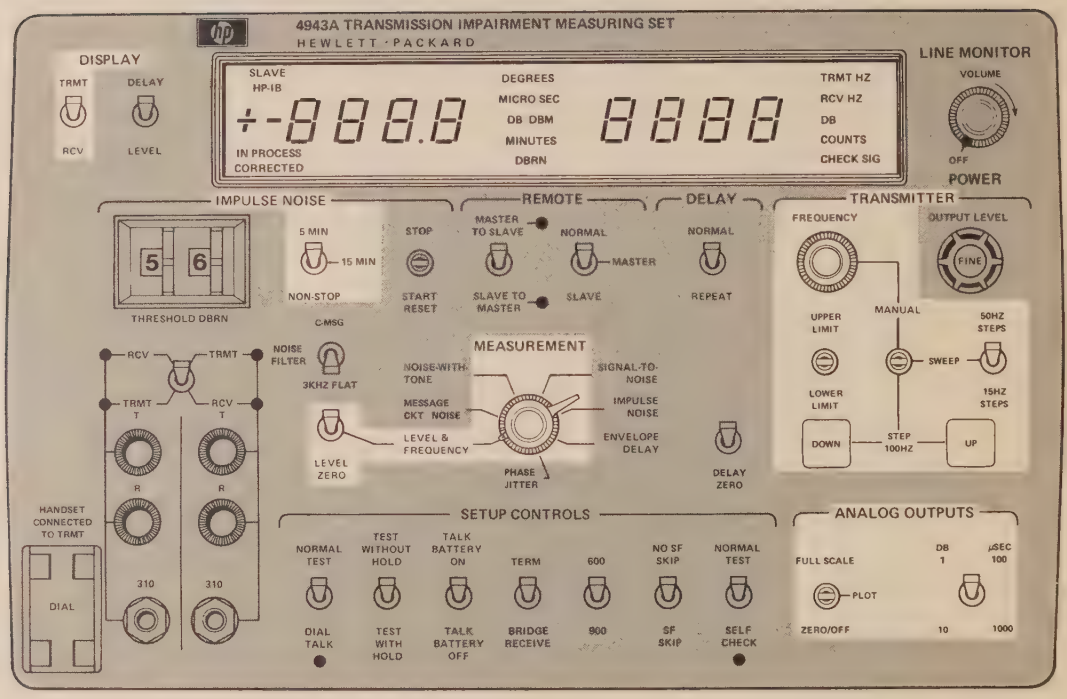
When selecting the SETUP CONTROLS-NORMAL TEST switch on 2-wire wet (DDD) line, make sure the SETUP CONTROLS switch is in the TEST WITH HOLD position before switching to NORMAL TEST. Failure to do so will cause the dial-up connection to be lost.

4. To return to talk or listen mode after normal tests are in progress, set SETUP CONTROLS switch to DIAL/TALK. Set RCV-TRMT jacks switch as indicated for 2-wire connection.

HOOKUP AND SETUP CONTROL SETTINGS FOR DIALING, TALKING, LISTENING, HOLDING AND TESTING

MODE	CIRCUIT		
	2-Wire Wet (DDD)	2-Wire Dry (DAA)	4-Wire Dry
HOOKUP	Transmit line connected to either RECEIVE/TRANSMIT JACKS	Transmit line connected to either RECEIVE/TRANSMIT JACKS	Transmit line connected to either RECEIVE/TRANSMIT JACKS
DIAL	DIAL/TALK; TALK BATTERY OFF; TEST WITHOUT HOLD; LEFT JACK TO TRMT (Dial with butt-in)		
TALK	DIAL/TALK; TALK BATTERY OFF; TEST WITH HOLD; LEFT JACK TO TRMT (Talk through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD; RIGHT JACK TO TRMT (Talk through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD (Talk through butt-in)
LISTEN	DIAL/TALK; TALK BATTERY OFF; TEST WITH HOLD; LEFT JACK TO TRMT (Listen through butt-in)	DIAL/TALK; TALK BATTERY ON; TEST WITHOUT HOLD; RIGHT JACK TO TRMT (Listen through butt-in)	Adjust LINE MONITOR as required (Listen through LINE MONITOR speaker)
TEST	TALK BATTERY OFF; TEST WITH HOLD; NORMAL TEST, (Throw TEST WITH HOLD switch **before** throwing NORMAL TEST switch).	TALK BATTERY ON; TEST WITHOUT HOLD; NORMAL TEST; RIGHT JACK TO RCV IF RECEIVE TEST SET	TALK BATTERY ON; TEST WITHOUT HOLD; NORMAL TEST

ANALOG OUTPUTS



Setting UPPER LIMIT and LOWER LIMIT Frequency Sweep

1. Set DISPLAY Switch to TRMT.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Adjust transmit frequency to desired LOWER LIMIT for sweep. NOTE: When in STEP 100 HZ, frequencies of 204 Hz to 3904 Hz can be selected. Frequencies other than those at step points can be selected by setting TRANSMITTER Switch to MANUAL and adjusting FREQUENCY Control.
4. Momentarily hold down TRANSMITTER Switch in LOWER LIMIT. This establishes start frequency for sweep.
5. Adjust transmit frequency to desired UPPER LIMIT for sweep. Refer to NOTE in step 3 above.
6. Momentarily hold up TRANSMITTER Switch in UPPER LIMIT. This establishes stop frequency for sweep.

ANALOG OUTPUTS

OSCILLOSCOPE or CRT DISPLAY of LEVEL & FREQUENCY or ENVELOPE DELAY

1. Connect SCOPE VERT BNC connector on 4943A rear panel to vertical axis input of oscilloscope or display.
2. Connect SCOPE HORIZ BNC connector on 4943A rear panel to horizontal axis input of oscilloscope or display.
3. Set ANALOG OUTPUTS Switch to ZERO/OFF.
4. Adjust oscilloscope position controls to position display to desired (0, 0) point on CRT.
5. Set ANALOG OUTPUTS Switch to FULL SCALE.
6. Adjust oscilloscope vertical sensitivity and horizontal volts/div controls to position display to desired (X max, Y max) point on CRT.
7. Set ANALOG OUTPUTS Switch to desired scale (1 DB/div, 100 μSEC/div or 10 DB/div, 1000 μSEC/div).
8. Set TRANSMITTER Switch to 50 HZ STEPS or 15 HZ STEPS, as desired.
9. Set ANALOG OUTPUTS Switch to PLOT.
10. Set MEASUREMENT Switch to LEVEL & FREQUENCY or ENVELOPE DELAY, as desired.
11. Set TRANSMITTER Switch to SWEEP. Observe plot of selected measurement versus frequency on CRT.

OSCILLOSCOPE or CRT DISPLAY OF MESSAGE CKT NOISE, NOISE-WITH-TONE, SIGNAL-TO-NOISE RATIO, IMPULSE NOISE or PHASE JITTER

1. Complete Steps 1 through 6 above.
2. Set ANALOG OUTPUTS Switch to PLOT.
3. Set MEASUREMENT Switch to desired measurement. Observe plot of selected measurement versus time on CRT.

X-Y RECORDER Plots of LEVEL & FREQUENCY and ENVELOPE DELAY

1. Connect PLOTTER VERT BNC connector on 4943A rear panel to vertical axis input of X-Y Recorder.
2. Connect PLOTTER HORIZ BNC connector on 4943A rear panel to horizontal axis input of X-Y Recorder.
3. Connect PLOTTER PEN LIFT BNC connector on 4943A rear panel to pen lift input of X-Y Recorder.

To calibrate X-Y Recorder chart:

4. Set TRANSMITTER Switch to STEP 100 HZ.
5. Set ANALOG OUTPUTS Switch to ZERO/OFF.
6. Adjust ZERO controls on X axis amplifier and Y axis amplifier of X-Y Recorder to position pen to (0, 0) point on chart paper.
7. Set ANALOG OUTPUTS Switch to FULL SCALE.
8. Adjust GAIN and VERNIER controls on X axis amplifier and Y axis amplifier of X-Y Recorder to position pen to (X max, Y max) point on chart paper.

To draw axis lines on X-Y Recorder chart:

9. Complete Steps 4 through 8 above.
10. Set DISPLAY Switch to RCV.
11. Set ANALOG OUTPUTS Switch to ZERO/OFF.

12a. To mark X axis in increments of 500 Hz, set MEASUREMENT Switch to LEVEL & FREQUENCY.

12b. To mark X axis in increments of 5 MIN. or 15 MIN., set MEASUREMENT Switch to IMPULSE NOISE. Set IMPULSE NOISE Switch to 5 MIN or 15 MIN, as desired.

12c. If no increment marks are desired on X axis, set MEASUREMENT Switch to MESSAGE CKT NOISE.

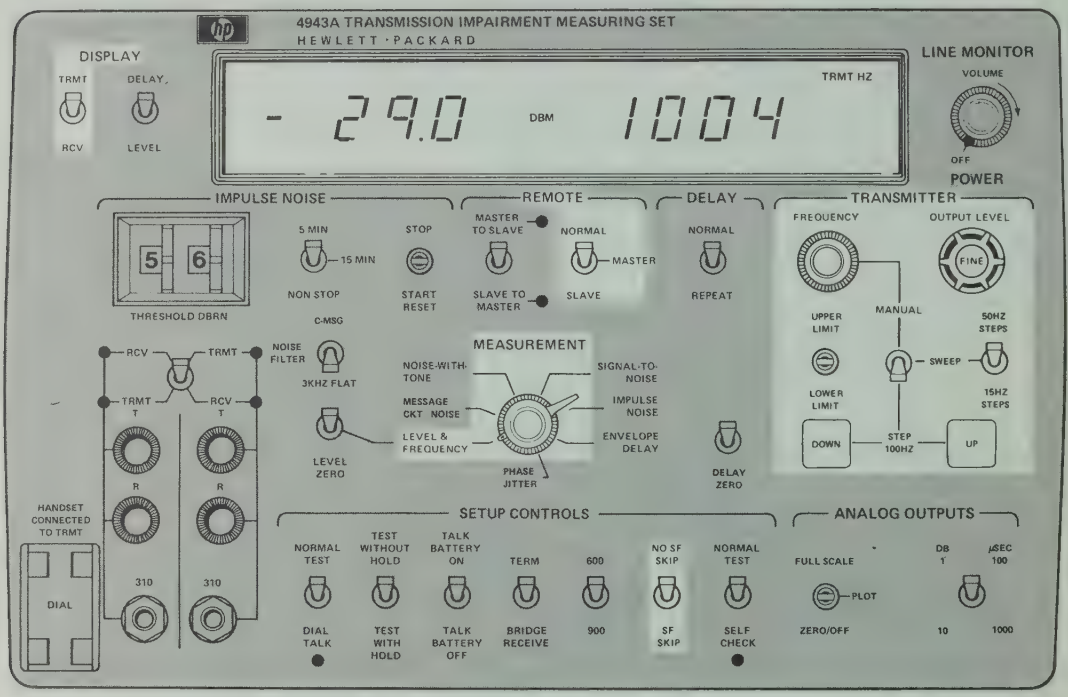
13. Momentarily hold down DELAY ZERO Switch. Observe that X and Y axes are drawn on chart paper.
14. Set ANALOG OUTPUTS Switch to desired scale (1 DB/div, 100 USEC/div or 10 DB/div, 1000 USEC/div).
15. Set TRANSMITTER Switch to 50 HZ STEPS or 15 HZ STEPS, as desired.
16. Set ANALOG OUTPUTS Switch to PLOT.
17. Set MEASUREMENT Switch to LEVEL & FREQUENCY or ENVELOPE DELAY, as desired.
18. Set TRANSMITTER Switch to SWEEP. Observe plot of selected measurement versus frequency on X-Y Recorder.

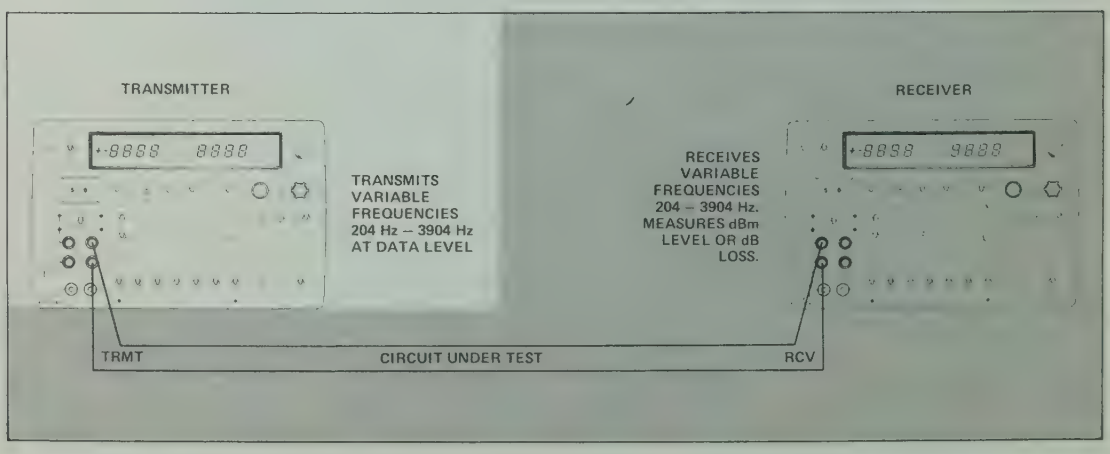
X-Y RECORDER Plots of MESSAGE CKT NOISE, NOISE-WITH-TONE, SIGNAL-TO-NOISE RATIO or PHASE JITTER

19. Complete Steps 1 through 13 above.
20. Set ANALOG OUTPUTS Switch to PLOT.
21. Set MEASUREMENT Switch to desired measurement. Observe plot of selected measurement versus time on X-Y Recorder.

NORMAL OPERATION PROCEDURES

LEVEL AND FREQUENCY NORMAL TRANSMITTER




TRANSMITTER
RECEIVER
TRANSMITS VARIABLE FREQUENCIES 204 Hz – 3904 Hz AT DATA LEVEL
RECEIVES VARIABLE FREQUENCIES 204 – 3904 Hz. MEASURES dBm LEVEL OR dB LOSS.
TRMT
CIRCUIT UNDER TEST
RCV

LEVEL AND FREQUENCY NORMAL TRANSMITTER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to TRMT.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. If SF signaling units are used in the network under test, set NO SF SKIP – SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
6. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP – DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

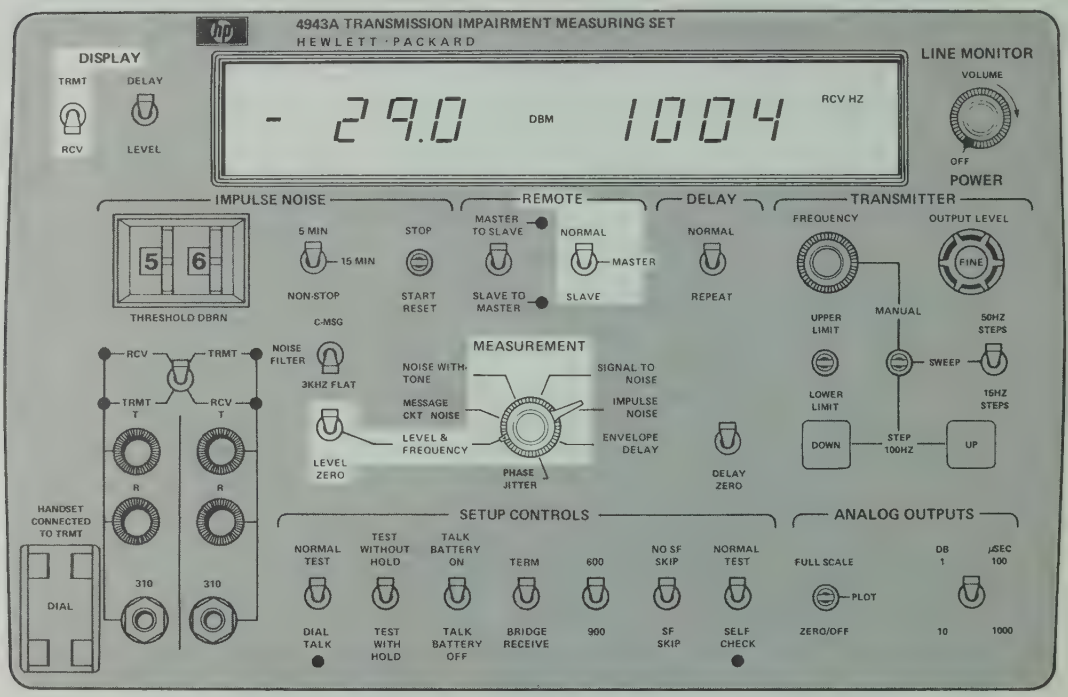
DATA LEVEL

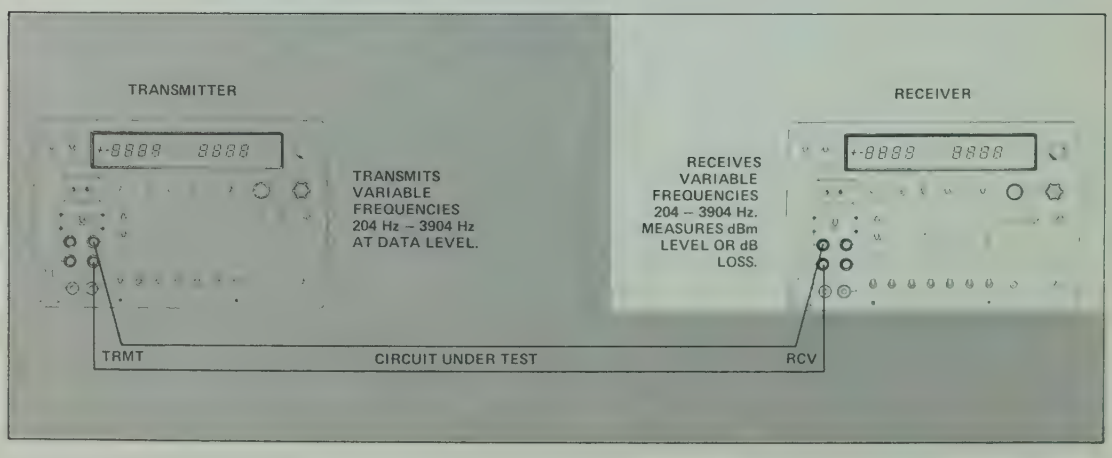
All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be - 29 dBm. Therefore, an output level of – 29 dBm would be applied in this case.

8. When requested by NORMAL RECEIVER Operator, transmit agreed upon test frequencies. When in STEP 100 HZ mode, frequencies of 204 Hz to 3904 Hz can be selected. Frequencies other than those at the step points can be selected by setting the TRANSMITTER Switch to MANUAL and adjusting the FREQUENCY Control.

See next pages for NORMAL RECEIVER procedures.

LEVEL AND FREQUENCY NORMAL RECEIVER




TRANSMITTER
RECEIVER
TRANSMITS VARIABLE FREQUENCIES 204 Hz – 3904 Hz AT DATA LEVEL.
RECEIVES VARIABLE FREQUENCIES 204 – 3904 Hz. MEASURES dBm LEVEL OR dB LOSS.
TRMT
CIRCUIT UNDER TEST
RCV

LEVEL AND FREQUENCY NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to RCV.

1000 HZ LOSS MEASUREMENT

4. Instruct NORMAL TRANSMITTER Operator to send 1004 Hz tone.
5. Observe RCV HZ (nominally 1004 Hz) in right display and received DBM level in left display.

FREQUENCY SHIFT MEASUREMENT

6. Observe RCV HZ while communicating with NORMAL TRANSMITTER Operator. Compare any difference between the transmitted and received frequency.

NOTE

The transmitting test set must transmit a frequency known to within ±0.5 Hz, such as another Hewlett-Packard Transmission Impairment Measuring Set.

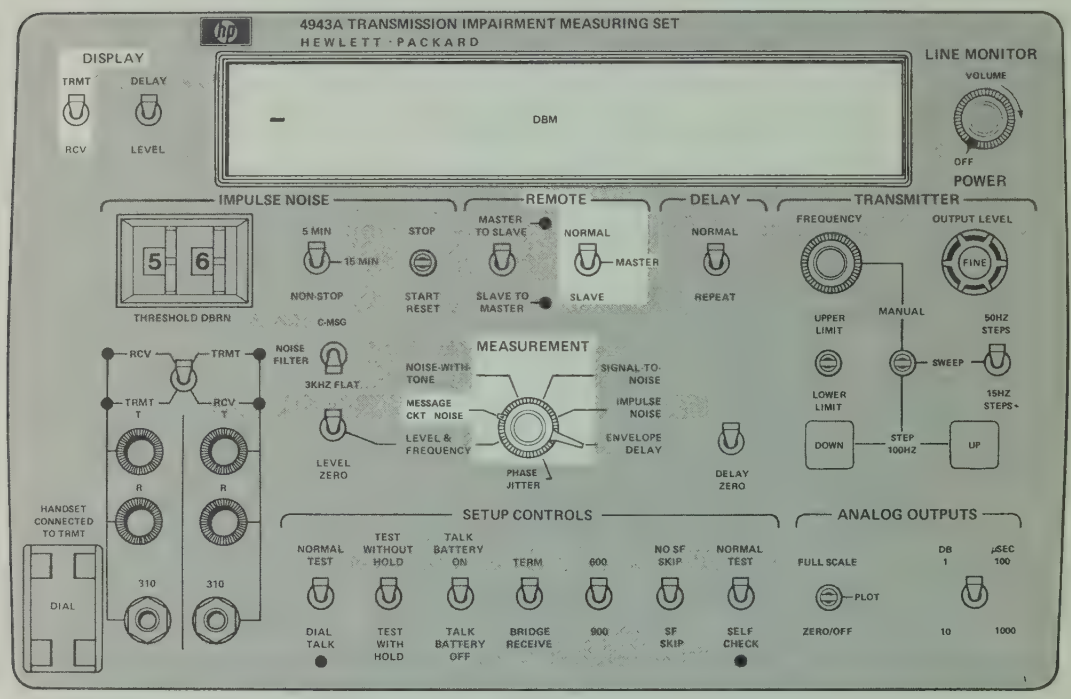
ATTENUATION DISTORTION MEASUREMENT

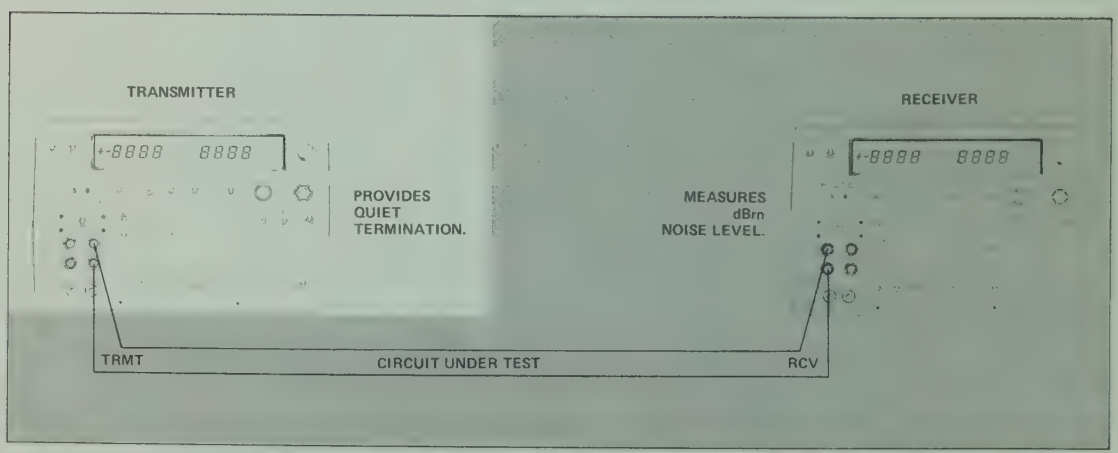
7. Momentarily hold down LEVEL ZERO Switch. This establishes a 0 dB reference at the reference frequency (1004 Hz).
8. Observe RCV HZ in right display and DB relative loss in left display, as agreed upon frequencies are transmitted. +DB indicates more loss and −DB indicates less loss, relative to the reference frequency.

NOTE

Attenuation Distortion measurements can also be made in absolute dBm. The test set is automatically in the dBm mode until the LEVEL ZERO Switch is operated. To return the test set to the dBm mode, momentarily rotate MEASUREMENT Switch to another position, then back to LEVEL & FREQUENCY again.

MESSAGE CIRCUIT NOISE NORMAL TRANSMITTER



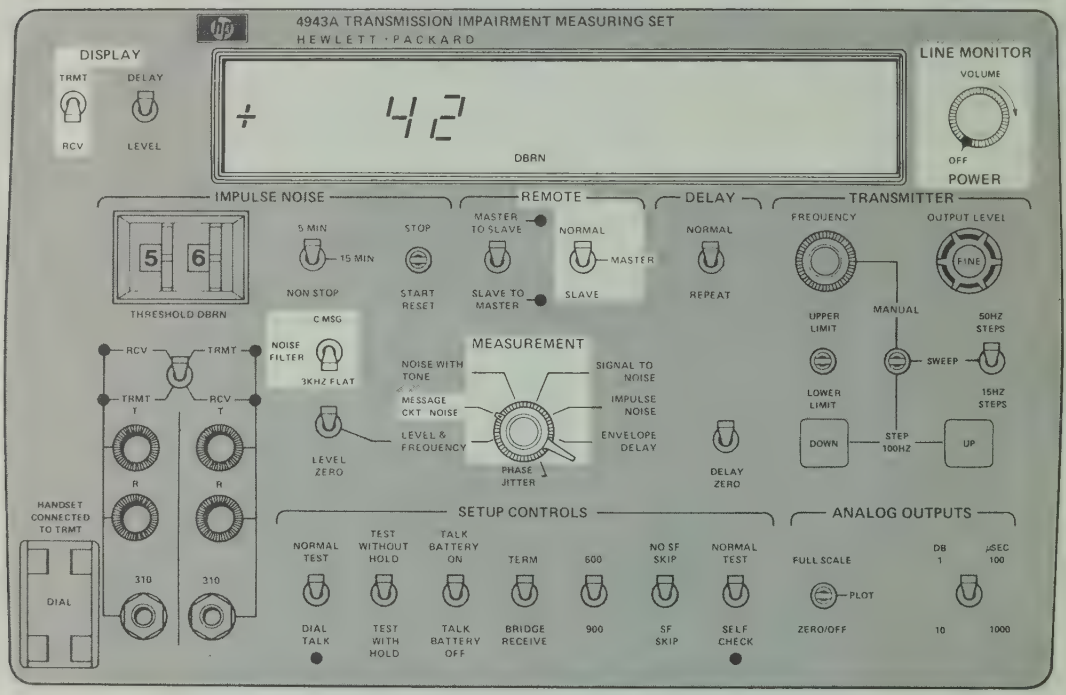


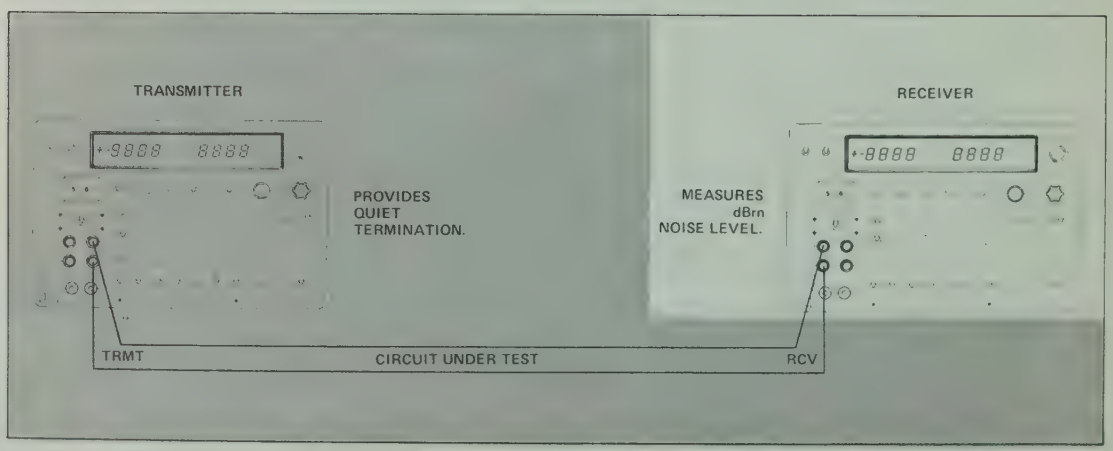
MESSAGE CIRCUIT NOISE NORMAL TRANSMITTER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to MESSAGE CKT NOISE. This provides the TRMT jack with a quiet termination.

See next pages for NORMAL RECEIVER procedures.

MESSAGE CIRCUIT NOISE NORMAL RECEIVER





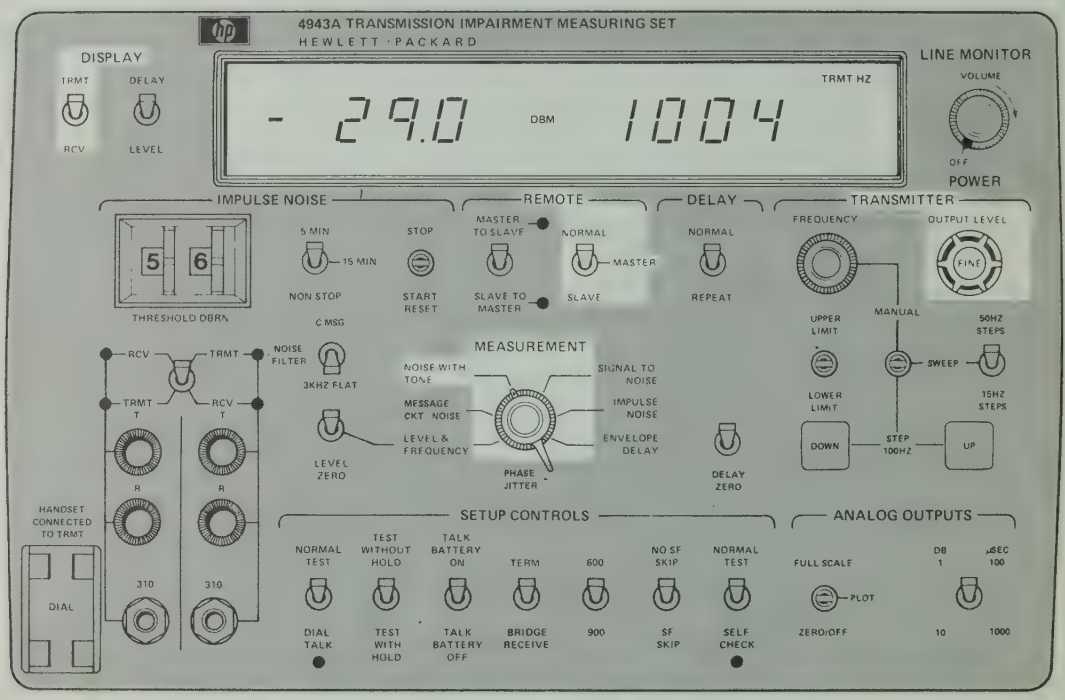
MESSAGE CIRCUIT NOISE NORMAL RECEIVER

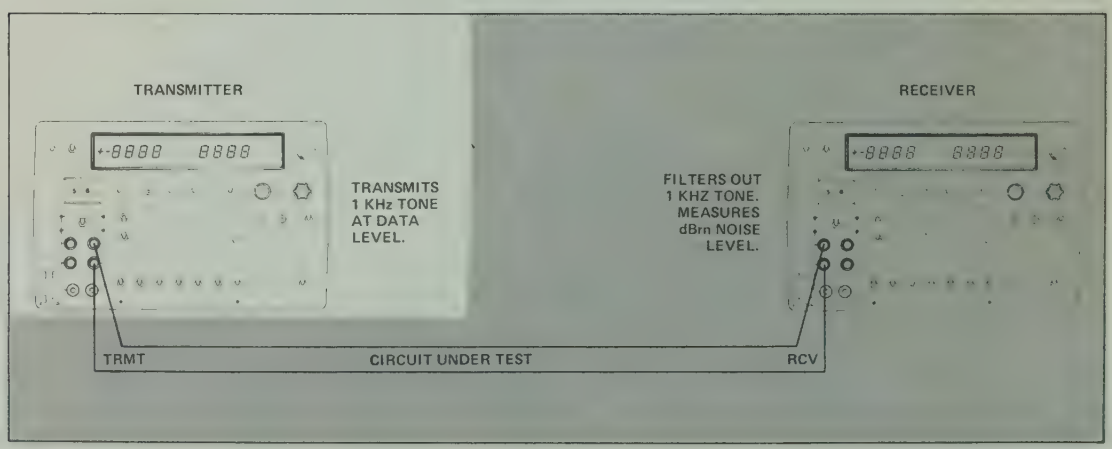
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to MESSAGE CKT NOISE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Observe DBRN noise level in left display. NOTE: A "–" sign in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

6. Adjust VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

NOISE-WITH-TONE NORMAL TRANSMITTER





NOISE-WITH-TONE NORMAL TRANSMITTER

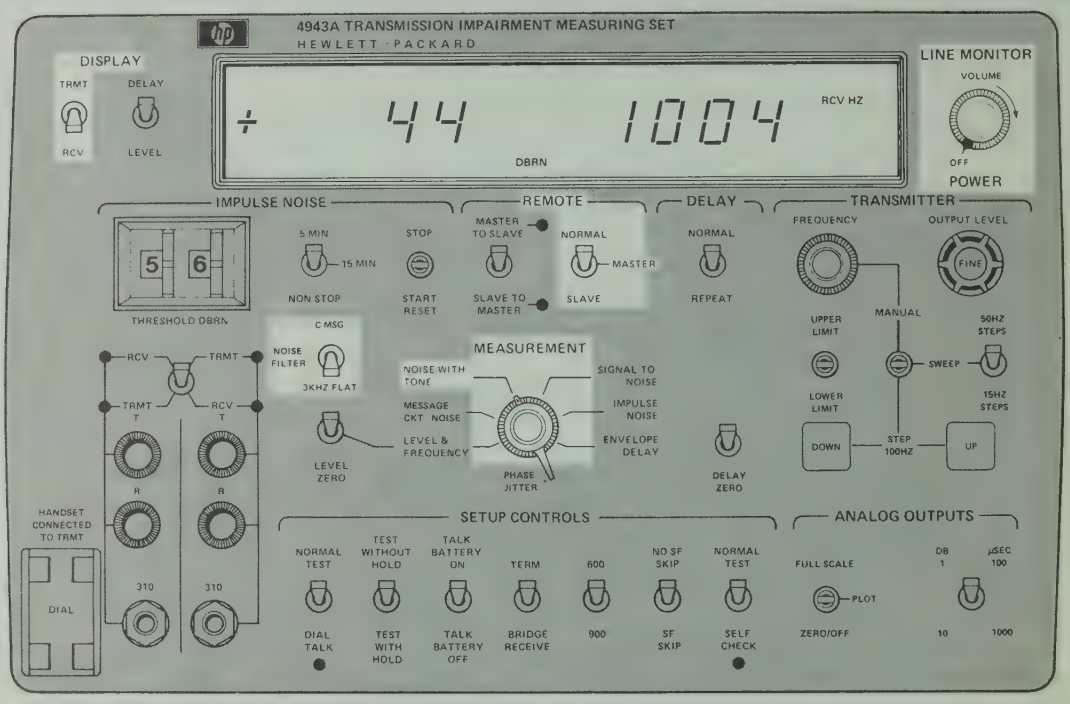
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NOISE-WITH-TONE.
3. Set DISPLAY Switch to TRMT.
4. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
5. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

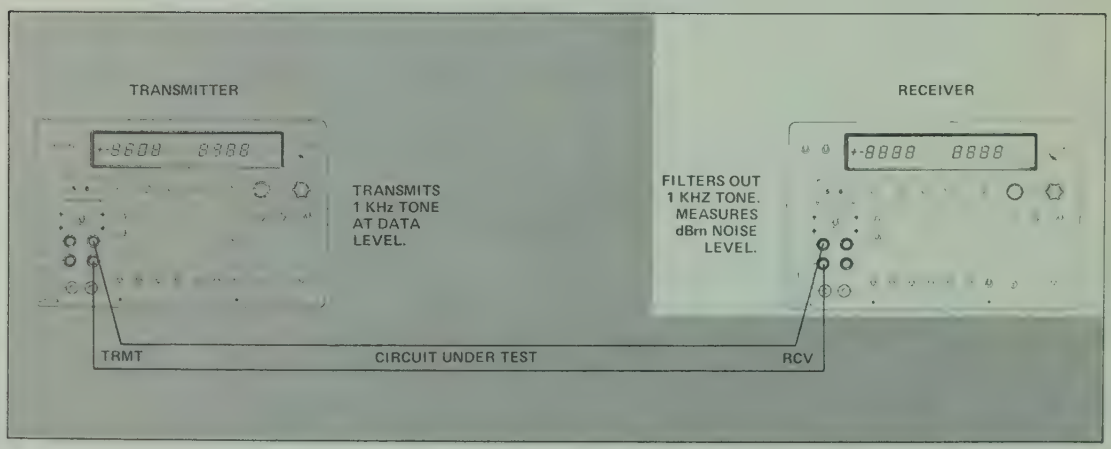
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

See next pages for NORMAL RECEIVER procedures.

NOISE-WITH-TONE NORMAL RECEIVER

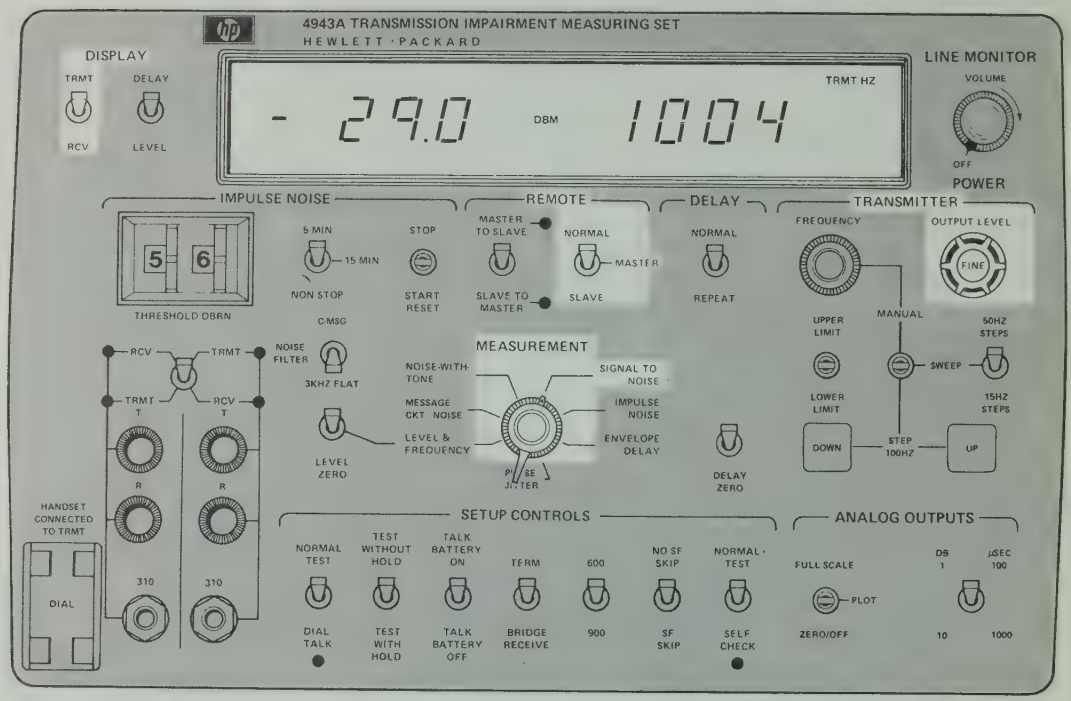


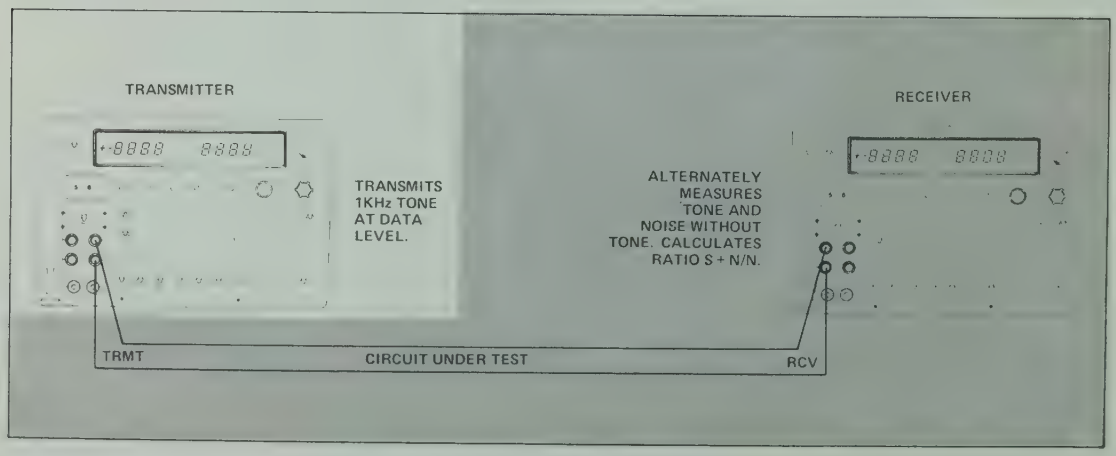


NOISE-WITH-TONE NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NOISE-WITH-TONE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Observe RCV HZ in right display. Verify that received frequency is between 995 Hz and 1025 Hz.
6. Adjust VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.
7. Observe DBRN noise level in left display. NOTE: A "–" sign in left display indicates underrange (<20 DBRN).

SIGNAL-TO-NOISE NORMAL TRANSMITTER





SIGNAL-TO-NOISE NORMAL TRANSMITTER

Set REMOTE Switch to NORMAL.

Set MEASUREMENT Switch to SIGNAL-TO-NOISE.

Set DISPLAY Switch to TRMT.

Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.

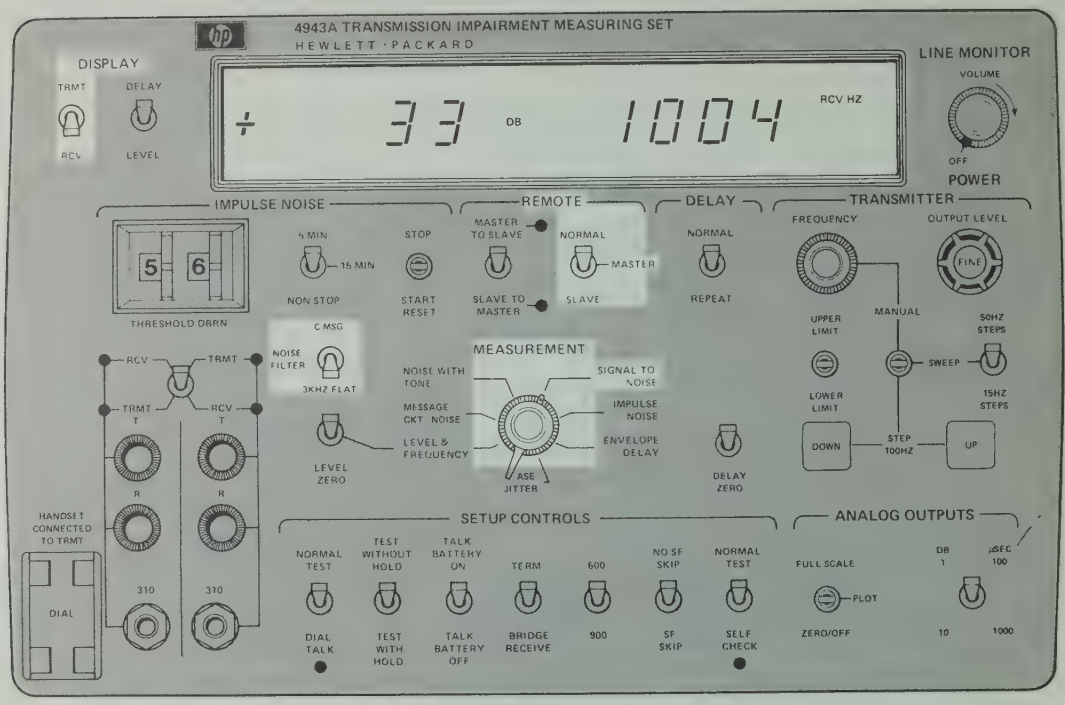
Adjust OUTPUT LEVEL control for "Data Level". Observe DBM level in left display.

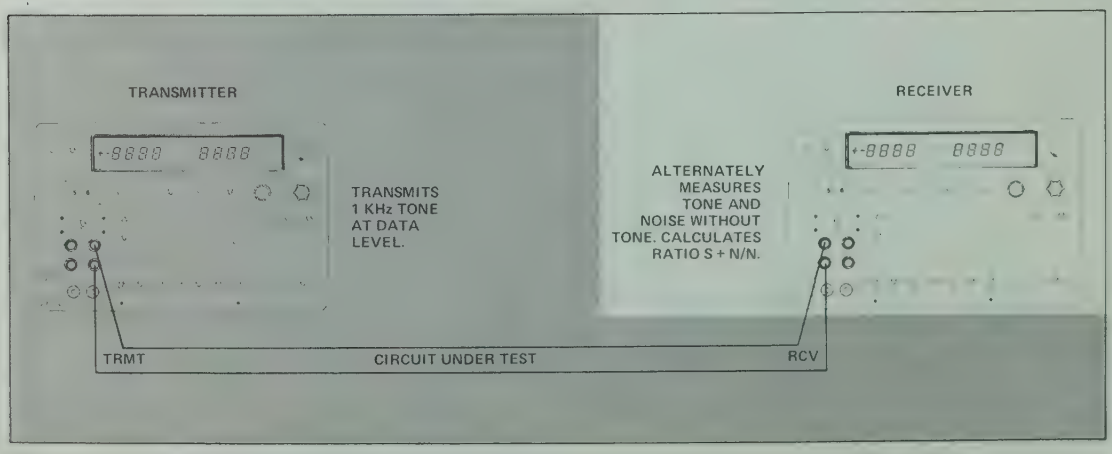
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

See next pages for NORMAL RECEIVER procedures.

SIGNAL-TO-NOISE NORMAL RECEIVER

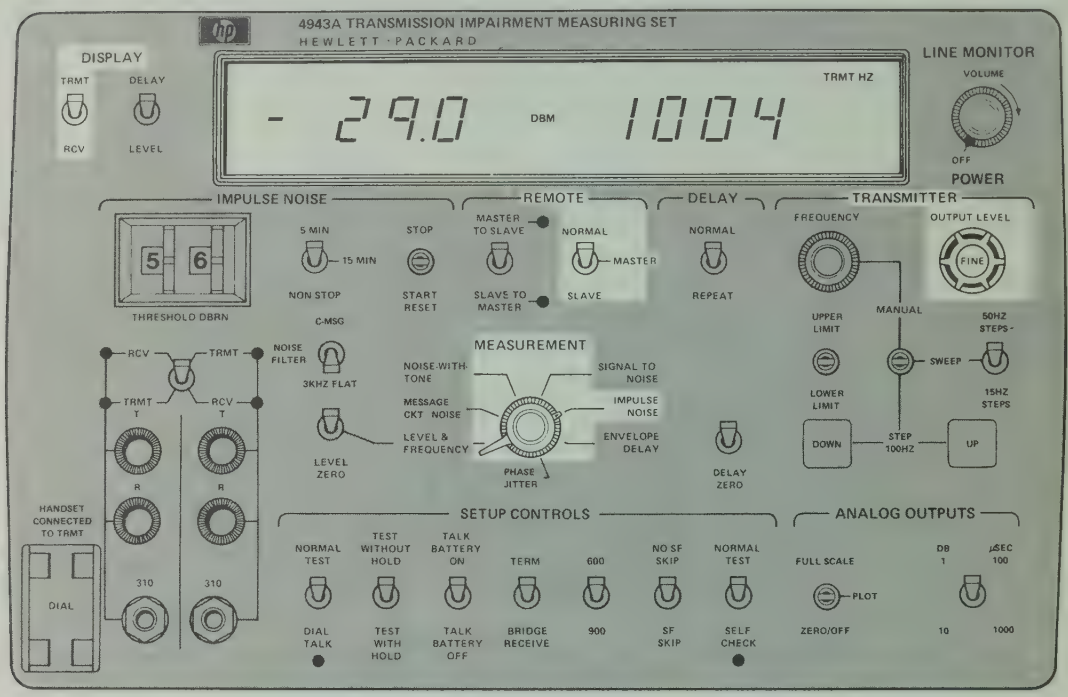


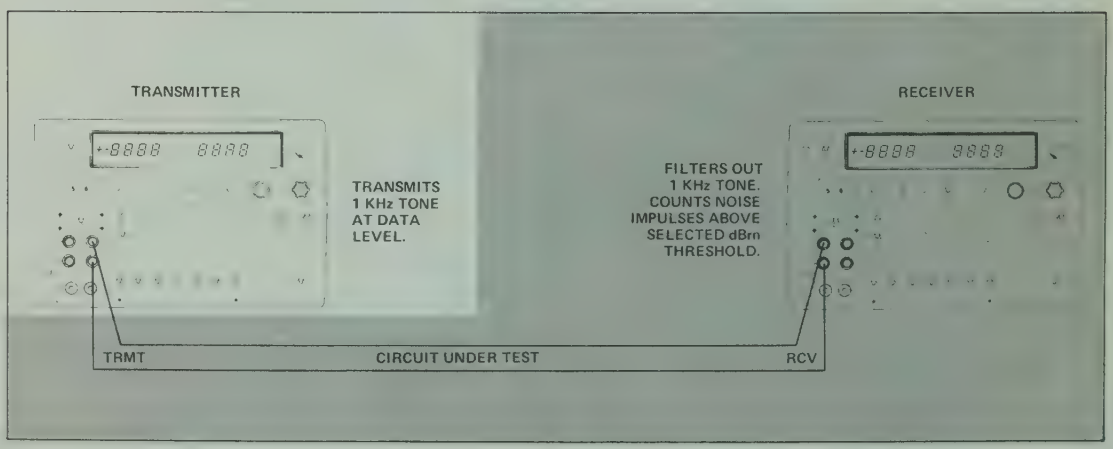


SIGNAL-TO-NOISE NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to SIGNAL-TO-NOISE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Observe RCV HZ in right display. Verify that received signal is between 995 Hz and 1025 Hz.
6. Observe DB signal-to-noise ratio (S+N/N) in left display. NOTE: A "–" sign in left display indicates underrange.

IMPULSE NOISE NORMAL TRANSMITTER





IMPULSE NOISE NORMAL TRANSMITTER

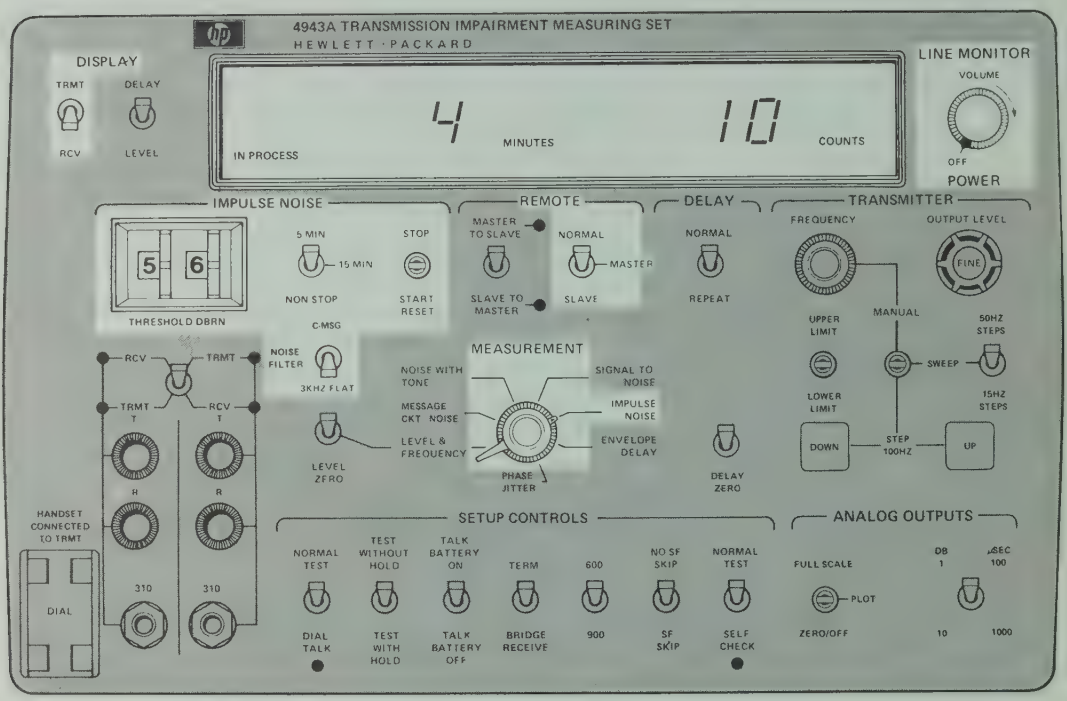
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to IMPULSE NOISE.
3. Set DISPLAY Switch to TRMT.
4. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
5. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

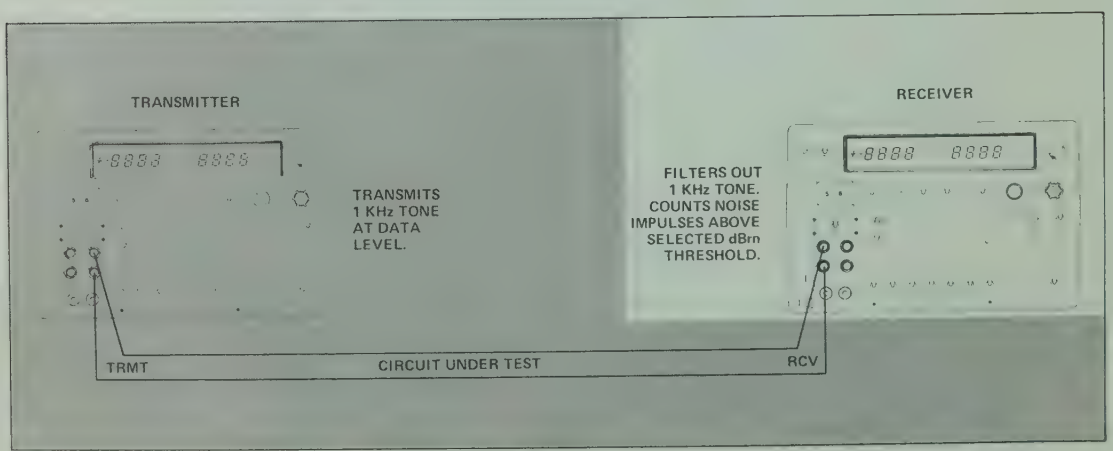
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

See next pages for NORMAL RECEIVER procedures.

IMPULSE NOISE NORMAL RECEIVER





IMPULSE NOISE NORMAL RECEIVER

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to IMPULSE NOISE.
3. Set DISPLAY Switch to RCV.
4. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
5. Set IMPULSE NOISE Thumbwheel Switches to desired DBRN THRESHOLD.
6. Set IMPULSE NOISE Switch to desired count interval (5 MIN, 15 MIN, or NON-STOP).
7. Momentarily hold down and release IMPULSE NOISE STOP-START/RESET Switch to START/RESET position. Observe that IN PROCESS Annunciator comes on.
8. Left display indicates count time (in minutes) remaining in 5 MIN and 15 MIN modes. Elapsed time is indicated for NON-STOP mode.

NOTE

If a carrier dropout of less than –40 dBm for more than one second occurs at any time during the counting interval, a minus (–) sign will be displayed in the left display. Presence of this sign may indicate an invalid test which should be re-run.

9. Observe that IN PROCESS Annunciator goes out at completion of 5 MIN or 15 MIN interval. Observe measured impulse noise COUNTS in right display.

NOTE

Count can be reset to zero and restarted at any time by momentarily holding switch to START/RESET position. Count can also be stopped at any time by momentarily holding switch to STOP position, however count must be restarted at zero counts.

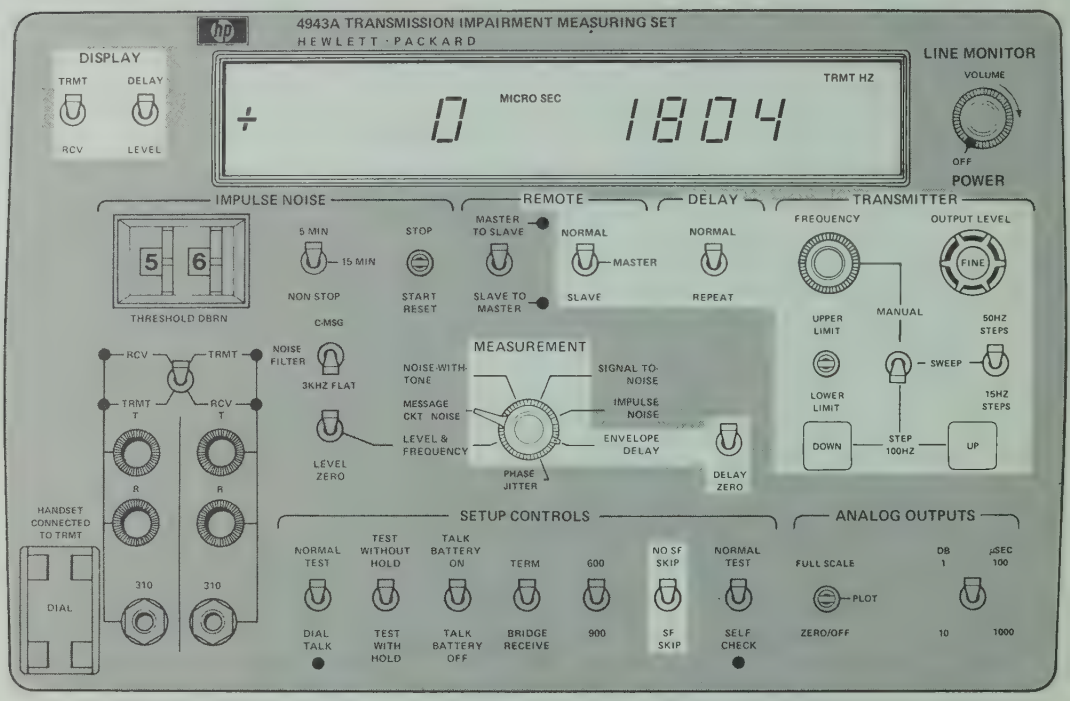
10. If NON-STOP mode is used, momentarily hold up and release IMPULSE NOISE STOP-START/RESET Switch to STOP position at end of desired counting interval. Observe measured impulse noise COUNTS in right display.

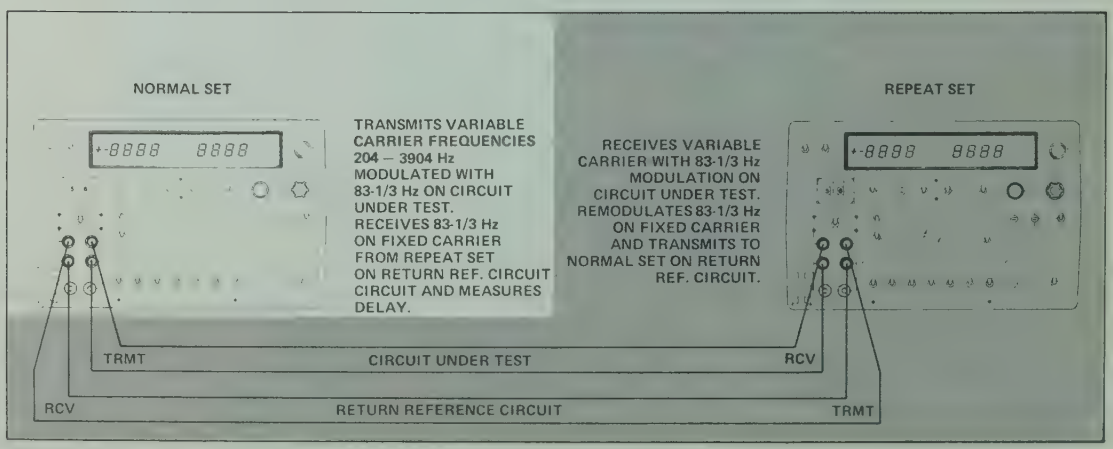
NOTE

The right display has a maximum capacity of 9999 COUNTS. If this capacity is exceeded, the display will indicate "H-12" to indicate "accumulator overflow condition".

11. Adjust VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

ENVELOPE DELAY-RETURN REFERENCE NORMAL TEST SET




NORMAL SET
TRANSMITS VARIABLE CARRIER FREQUENCIES 204 – 3904 Hz MODULATED WITH 83-1/3 Hz ON CIRCUIT UNDER TEST. RECEIVES 83-1/3 Hz ON FIXED CARRIER FROM REPEAT SET ON RETURN REF. CIRCUIT CIRCUIT AND MEASURES DELAY.
REPEAT SET
RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION ON CIRCUIT UNDER TEST. REMODULATES 83-1/3 Hz ON FIXED CARRIER AND TRANSMITS TO NORMAL SET ON RETURN REF. CIRCUIT.
TRMT
CIRCUIT UNDER TEST
RCV
RCV
RETURN REFERENCE CIRCUIT
TRMT

ENVELOPE DELAY-RETURN REFERENCE NORMAL TEST SET

1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to TRMT Jack. Connect Return Reference pair to RCV Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAY Switches to TRMT and LEVEL.
5. Set DELAY Switch to NORMAL.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. When *Repeat Test Set* operator has completed *his Step 7,* set DISPLAY Switch to RCV.
8. Notify *Repeat Test Set* operator that you have completed *your Step 7.*
9. Observe received DBM level in left display. This level must be −40 dBm or greater for valid measurements.
10. Set DISPLAY Switches to TRMT and DELAY.
11. Set TRANSMITTER Switch to STEP 100 HZ.
12. If SF signaling units are used in the network under test, set NO SF SKIP-SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
13. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
14. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

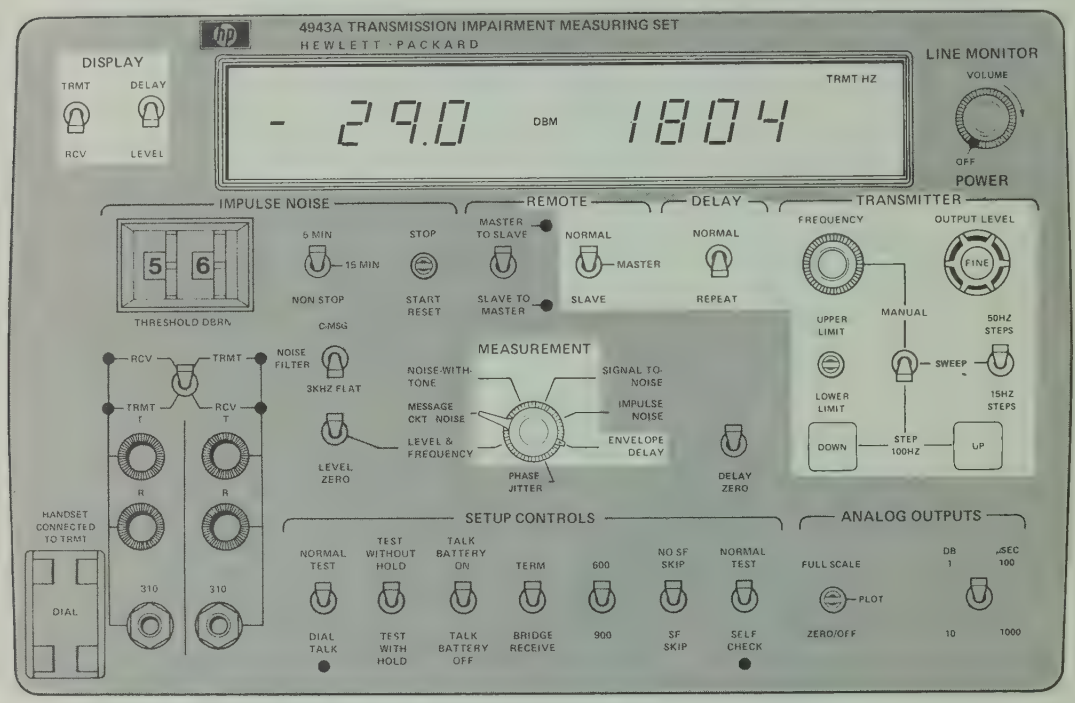
NOTE

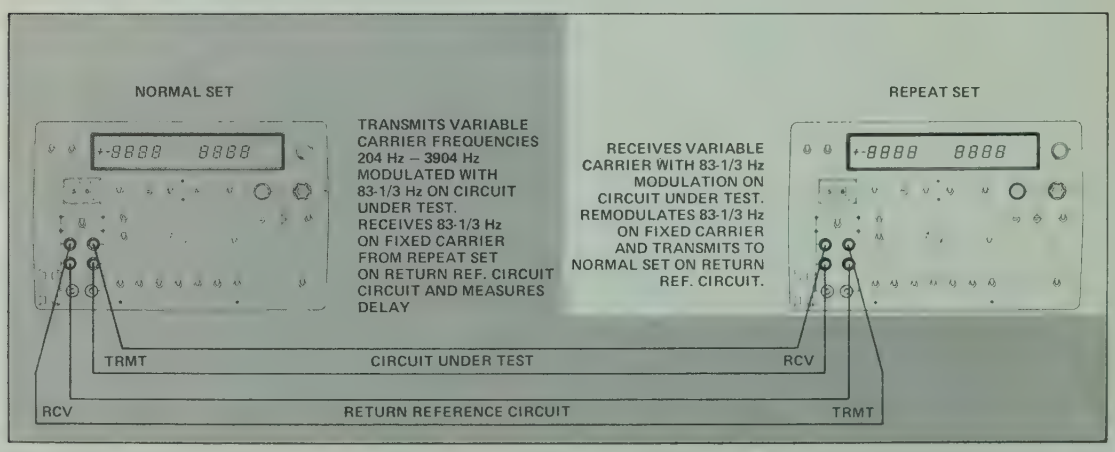
This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

15. Select desired test frequencies using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
16. At each test frequency, observe ± MICRO SEC envelope delay in left display. If readings vary, observe for an arithmetic mean (average).

See next pages for REPEAT TEST SET procedures.

ENVELOPE DELAY-RETURN REFERENCE REPEAT TEST SET




NORMAL SET
TRANSMITS VARIABLE CARRIER FREQUENCIES 204 Hz – 3904 Hz MODULATED WITH 83-1/3 Hz ON CIRCUIT UNDER TEST.
RECEIVES 83-1/3 Hz ON FIXED CARRIER FROM REPEAT SET ON RETURN REF. CIRCUIT CIRCUIT AND MEASURES DELAY
RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION ON CIRCUIT UNDER TEST. REMODULATES 83-1/3 Hz ON FIXED CARRIER AND TRANSMITS TO NORMAL SET ON RETURN REF. CIRCUIT.
REPEAT SET
TRMT
CIRCUIT UNDER TEST
RCV
RCV
RETURN REFERENCE CIRCUIT
TRMT

ENVELOPE DELAY-RETURN REFERENCE REPEAT TEST SET

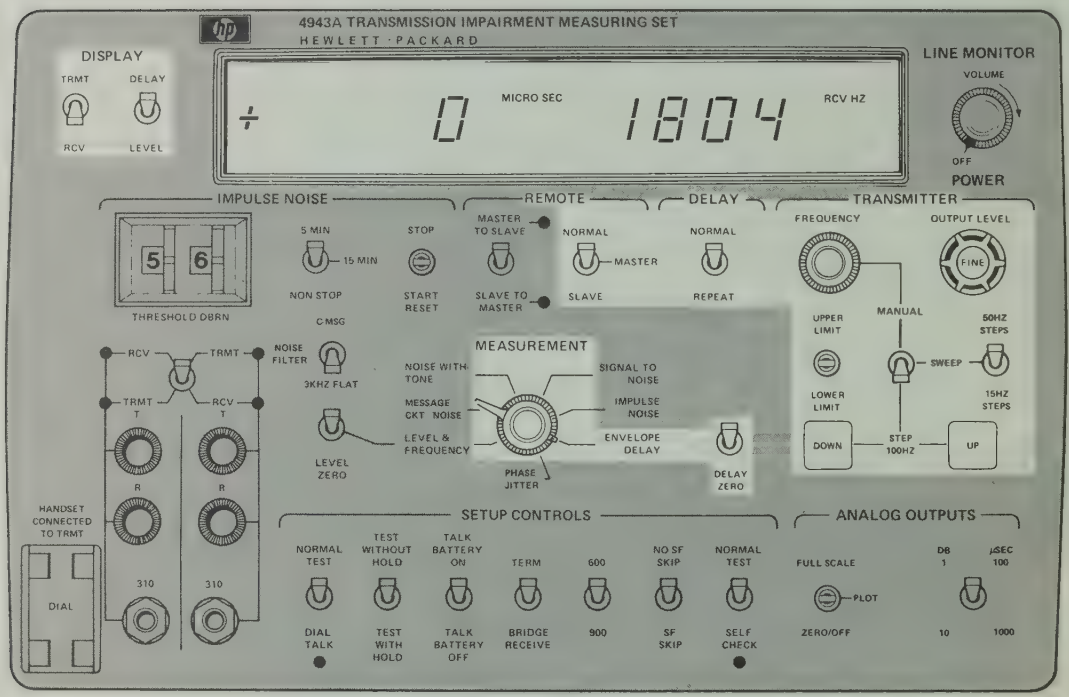
1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to RCV Jack. Connect Return Reference pair to TRMT Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAYS Switches to TRMT and LEVEL.
5. Set DELAY Switch to REPEAT.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

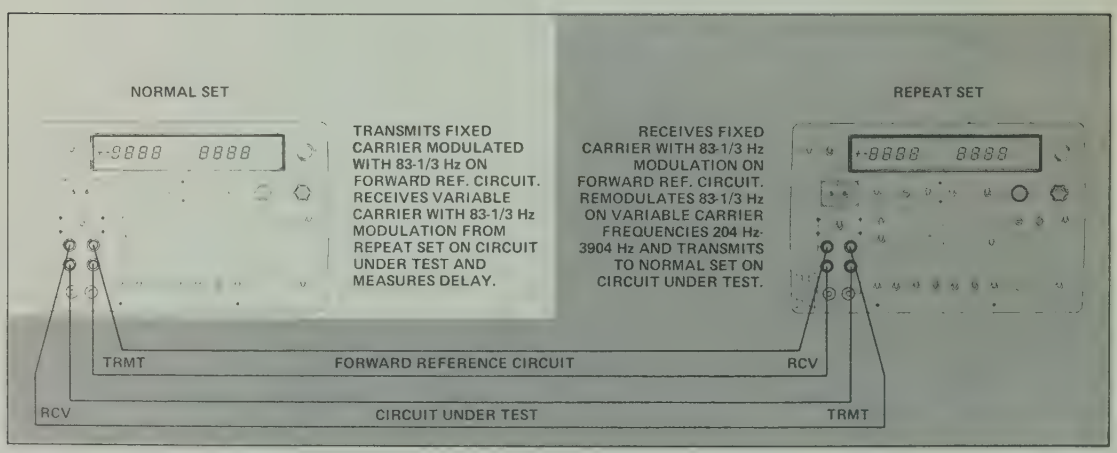
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set TRANSMITTER Switch to STEP 100 HZ. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
8. Notify *Normal Test Set* operator that you have completed *your Step 7.*
9. When *Normal Test Set* operator notifies you that he has completed *his Step 7,* set DISPLAY Switch to RCV.
10. Monitor DBM received level in left display to be sure it remains −40 dBm or greater throughout the measurements.

ENVELOPE DELAY-FORWARD REFERENCE NORMAL TEST SET




NORMAL SET
TRANSMITS FIXED CARRIER MODULATED WITH 83-1/3 Hz ON FORWARD REF. CIRCUIT. RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION FROM REPEAT SET ON CIRCUIT UNDER TEST AND MEASURES DELAY.
RECEIVES FIXED CARRIER WITH 83-1/3 Hz MODULATION ON FORWARD REF. CIRCUIT. REMODULATES 83-1/3 Hz ON VARIABLE CARRIER FREQUENCIES 204 Hz-3904 Hz AND TRANSMITS TO NORMAL SET ON CIRCUIT UNDER TEST.
REPEAT SET
TRMT
FORWARD REFERENCE CIRCUIT
RCV
RCV
CIRCUIT UNDER TEST
TRMT

ENVELOPE DELAY-FORWARD REFERENCE NORMAL TEST SET

1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to RCV Jack. Connect Forward Reference pair to TRMT Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAY Switches to TRMT and LEVEL.
5. Set DELAY Switch to NORMAL.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

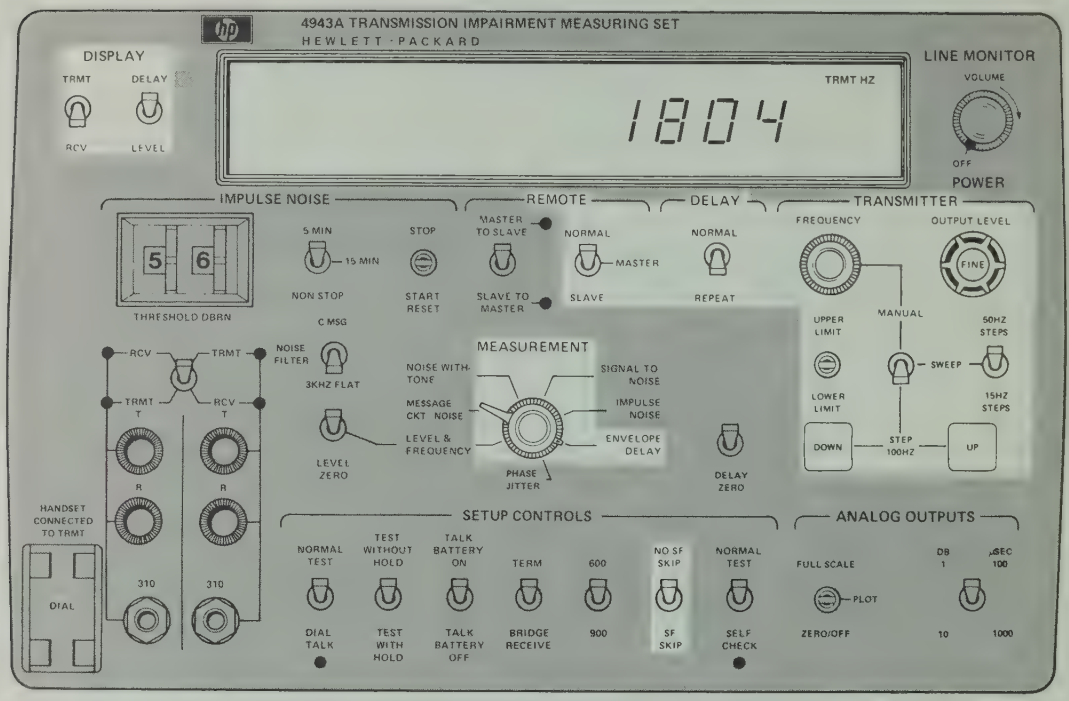
7. Set TRANSMITTER Switch to STEP 100 HZ. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
8. When *Repeat Test Set* operator has completed *his Step 9,* set DISPLAY Switch to RCV.
9. Notify *Repeat Test Set* operator that you have completed *your Step 7.*
10. Observe received DBM level in left display. This level must be −40 dBm or greater for valid measurements.
11. Set DISPLAY Switch to DELAY.
12. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

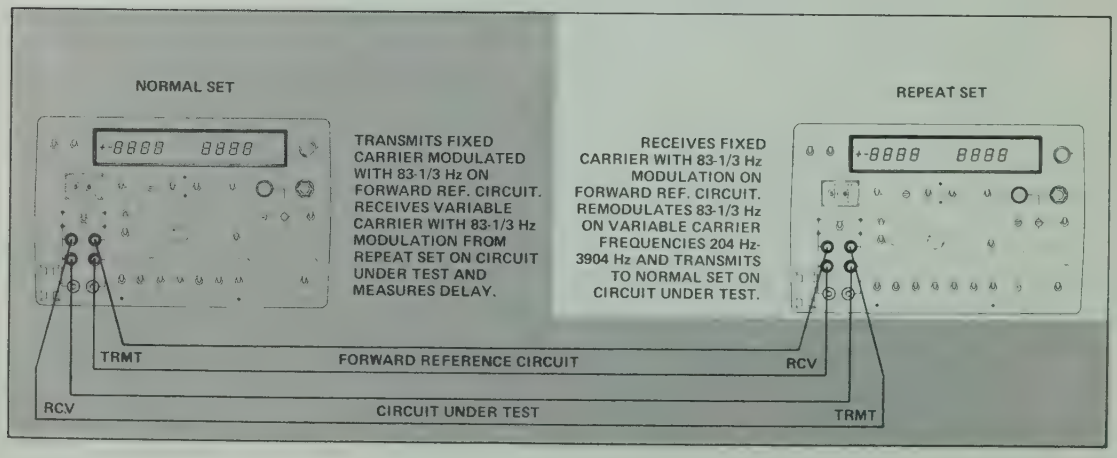
NOTE

This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

13. Notify *Repeat Test Set* operator to begin sending the agreed upon test frequencies.
14. At each test frequency, observe ± MICRO SEC envelope delay in left display. If readings vary, observe for an arithmetic mean (average). Observe RCV HZ in right display.

ENVELOPE DELAY-FORWARD REFERENCE REPEAT TEST SET




NORMAL SET
TRANSMITS FIXED CARRIER MODULATED WITH 83-1/3 Hz ON FORWARD REF. CIRCUIT. RECEIVES VARIABLE CARRIER WITH 83-1/3 Hz MODULATION FROM REPEAT SET ON CIRCUIT UNDER TEST AND MEASURES DELAY.
RECEIVES FIXED CARRIER WITH 83-1/3 Hz MODULATION ON FORWARD REF. CIRCUIT. REMODULATES 83-1/3 Hz ON VARIABLE CARRIER FREQUENCIES 204 Hz-3904 Hz AND TRANSMITS TO NORMAL SET ON CIRCUIT UNDER TEST.
REPEAT SET
TRMT
FORWARD REFERENCE CIRCUIT
RCV
RCV
CIRCUIT UNDER TEST
TRMT

ENVELOPE DELAY-FORWARD REFERENCE REPEAT TEST SET

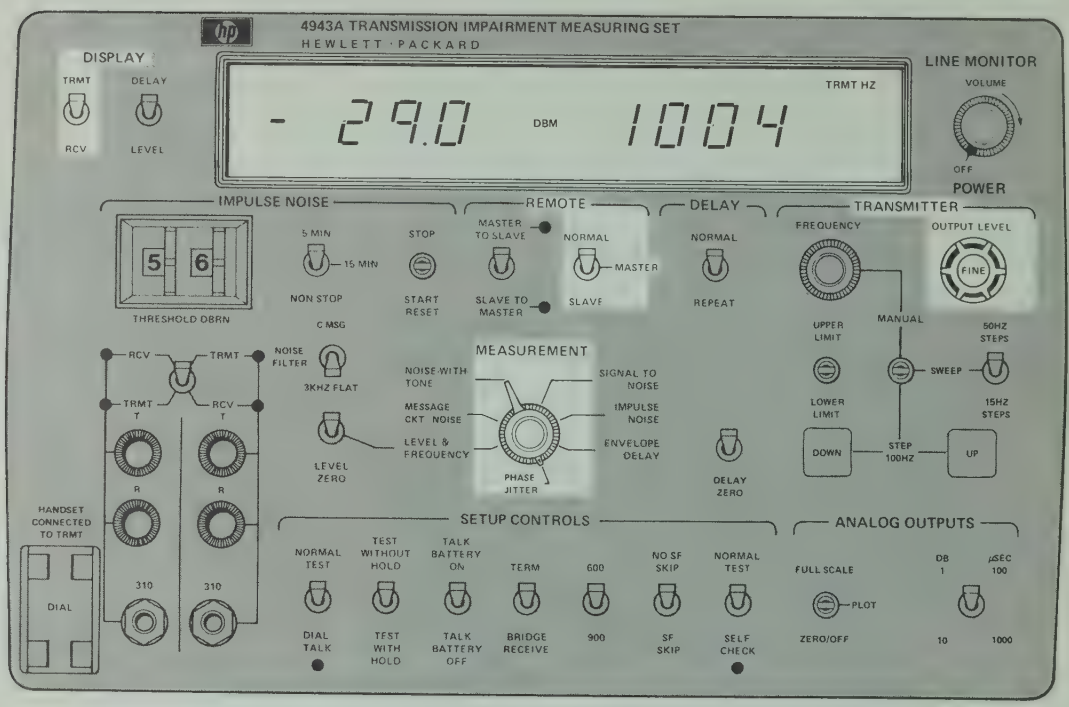
1. Set REMOTE Switch to NORMAL.
2. Connect pair to be tested to TRMT Jack. Connect Forward Reference pair to RCV Jack.
3. Set MEASUREMENT Switch to ENVELOPE DELAY.
4. Set DISPLAY Switches to TRMT and LEVEL.
5. Set DELAY Switch to REPEAT.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

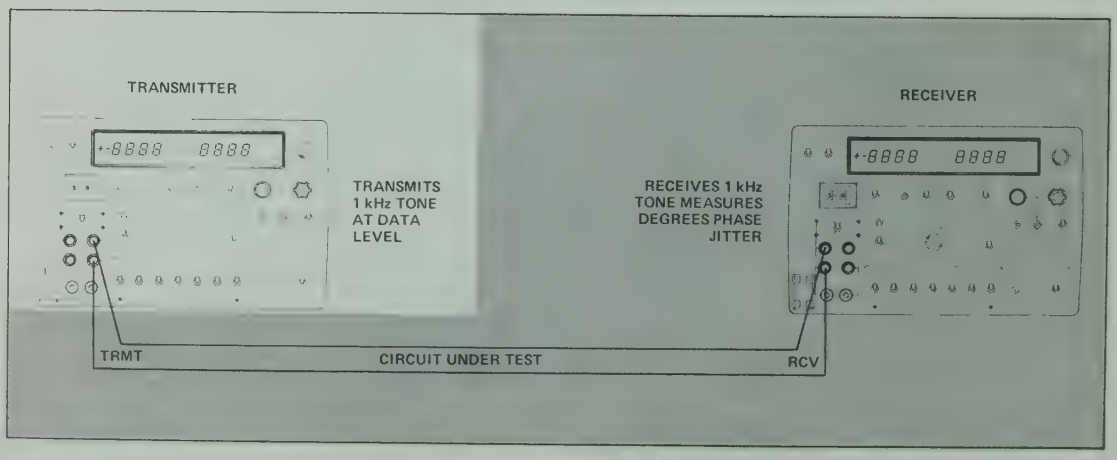
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set TRANSMITTER Switch to STEP 100 HZ.
8. If SF signaling units are used on the circuit under test, set NO SF SKIP — SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
9. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons.
10. Notify *Normal Test Set* operator that you have completed *your Step 9.*
11. When *Normal Test Set* operator notifies you that he has completed *his Step 7,* set DISPLAY Switch to DELAY.
12. When requested by *Normal Test Set* operator, transmit agreed upon frequencies using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.

PHASE JITTER NORMAL TRANSMITTER





PHASE JITTER NORMAL TRANSMITTER

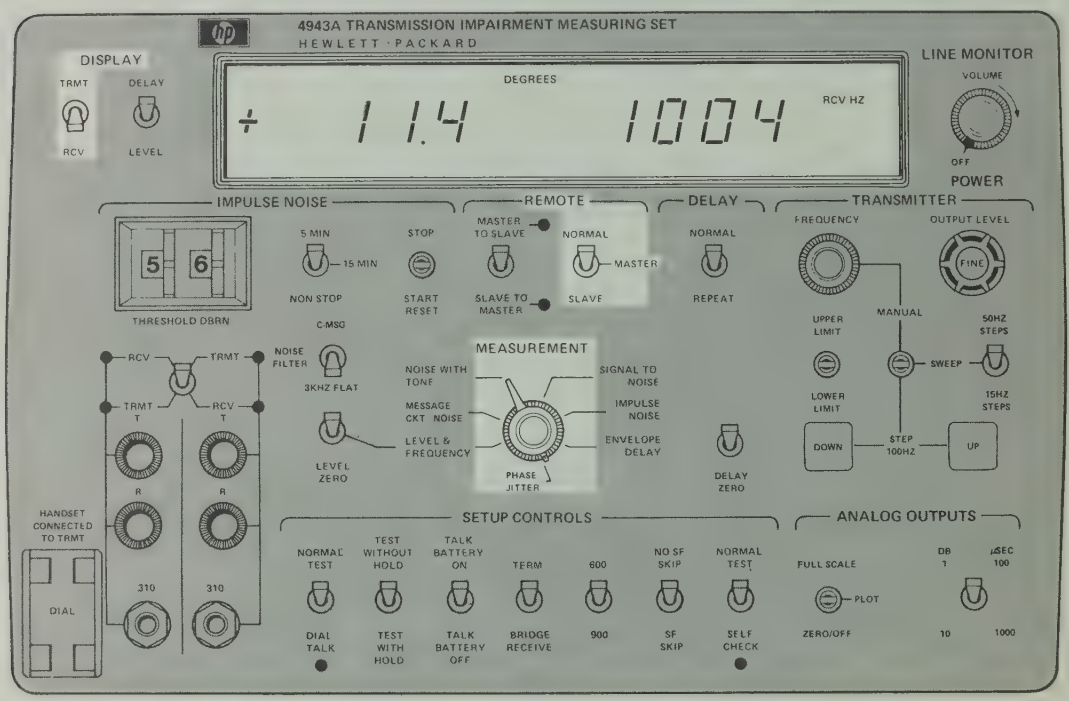
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to PHASE JITTER.
3. Set DISPLAY Switch to TRMT.
4. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
5. Adjust OUTPUT LEVEL control for "Data Level". Observe DBM level in left display.

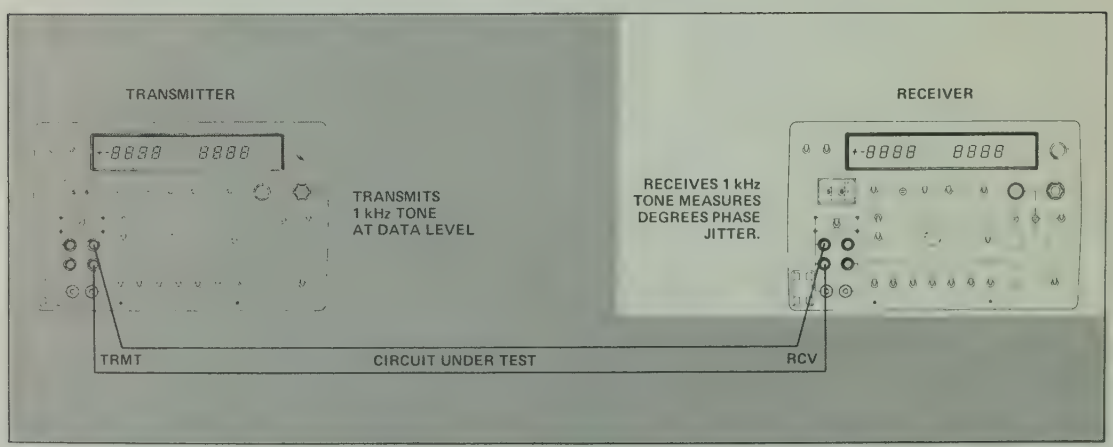
DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

See next pages for NORMAL RECEIVER procedures.

PHASE JITTER NORMAL RECEIVER





PHASE JITTER NORMAL RECEIVER

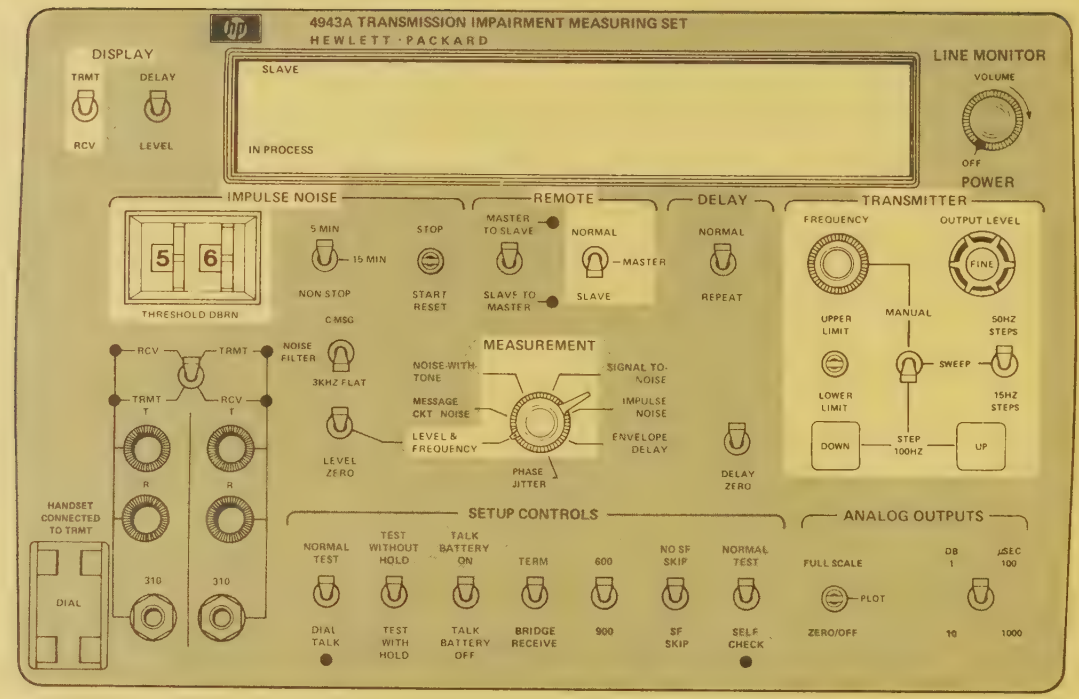
1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to PHASE JITTER.
3. Set DISPLAY Switch to RCV.
4. Observe RCV HZ in right display. Verify that received frequency is between 995 Hz and 1025 Hz.
5. Observe DEGREES phase jitter in left display. If readings vary, observe for an arithmetic mean (average).

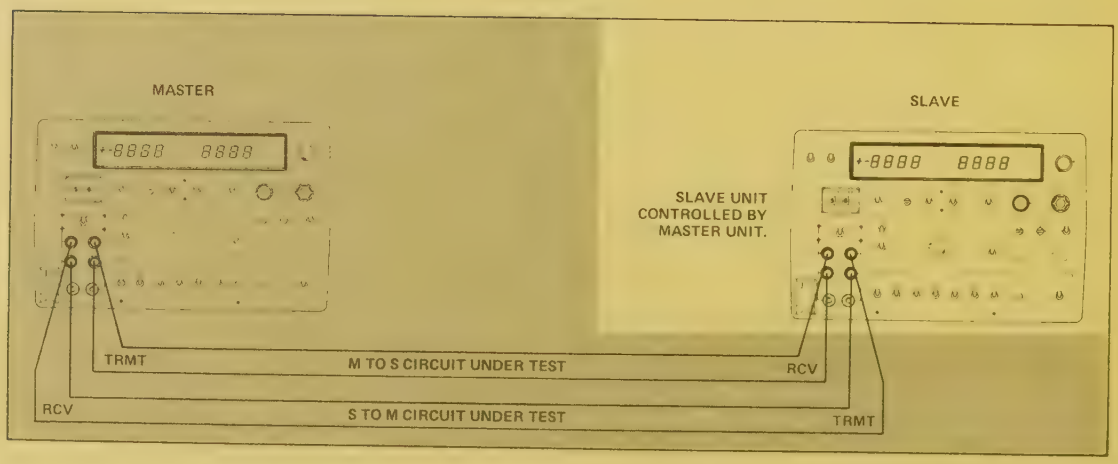
NOTE

Display of only a (+) sign indicates that phase jitter is greater than 40 DEGREES.

MASTER/SLAVE OPERATION PROCEDURES

SLAVE SETUP


4943A TRANSMISSION IMPAIRMENT MEASURING SET
HEWLETT · PACKARD
DISPLAY
TRMT
DELAY
RCV
LEVEL
SLAVE
IN PROCESS
LINE MONITOR
VOLUME
OFF
POWER
IMPULSE NOISE
5 MIN
15 MIN
NON-STOP
THRESHOLD DBRN
STOP
START RESET
REMOTE
MASTER TO SLAVE
SLAVE TO MASTER
NORMAL
MASTER
SLAVE
DELAY
NORMAL
REPEAT
TRANSMITTER
FREQUENCY
OUTPUT LEVEL
FINE
MANUAL
UPPER LIMIT
LOWER LIMIT
SWEEP
50HZ STEPS
15HZ STEPS
DOWN
STEP 100HZ
UP
C-MSG
NOISE FILTER
3KHZ FLAT
MEASUREMENT
NOISE-WITH-TONE
MESSAGE CKT NOISE
LEVEL & FREQUENCY
SIGNAL TO-NOISE
IMPULSE NOISE
ENVELOPE DELAY
PHASE JITTER
LEVEL ZERO
DELAY ZERO
RCV
TRMT
T
R
HANDSET CONNECTED TO TRMT
DIAL
310
SETUP CONTROLS
NORMAL TEST
TEST WITHOUT HOLD
TALK BATTERY ON
TERM
600
NO SF SKIP
NORMAL TEST
DIAL TALK
TEST WITH HOLD
TALK BATTERY OFF
BRIDGE RECEIVE
900
SF SKIP
SELF CHECK
ANALOG OUTPUTS
FULL SCALE
PLOT
ZERO/OFF
DB
1
10
µSEC
100
1000


MASTER
SLAVE
SLAVE UNIT CONTROLLED BY MASTER UNIT.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

SLAVE SETUP

1. Perform SETUP & TURN ON procedures through Step 9.
2. Set REMOTE Switch to NORMAL.
3. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
4. Set DISPLAY Switch to TRMT.
5. Set TRANSMITTER Switch to STEP 100 HZ.
6. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL for "Data Level". Observe DBM in left display.

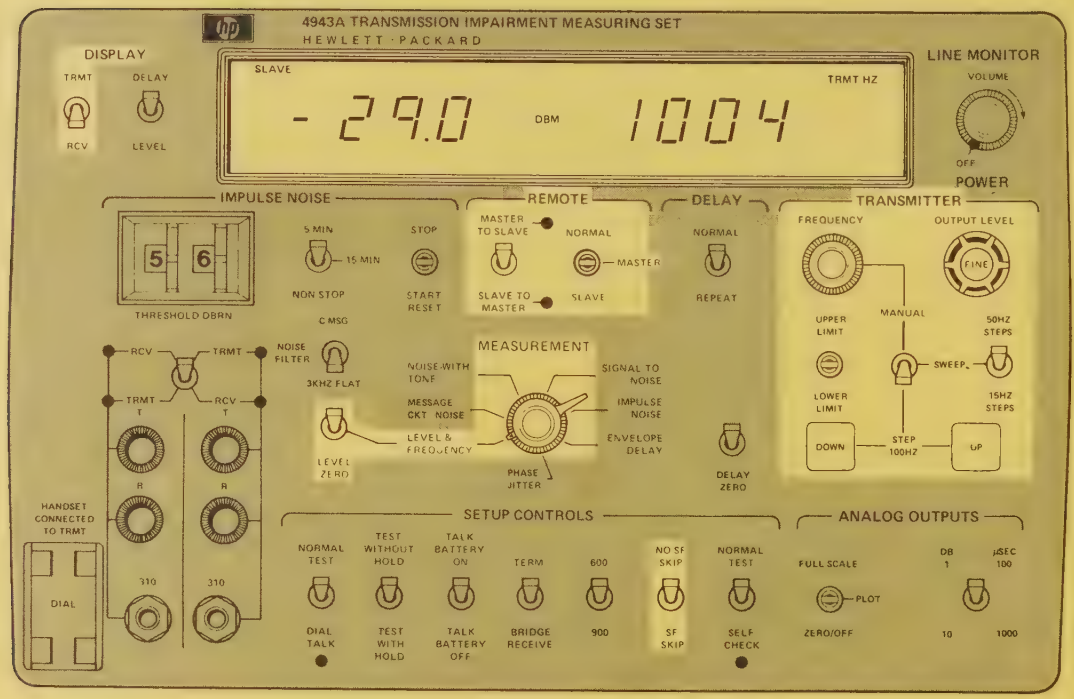
DATA LEVEL

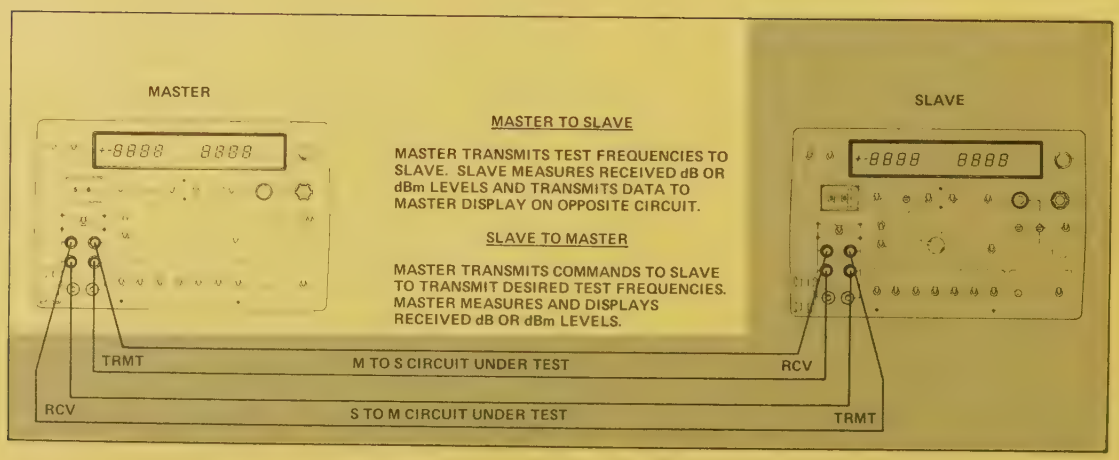
All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

8. If IMPULSE NOISE is to be measured, set IMPULSE NOISE Thumbwheel Switches to desired DBRN THRESHOLD.
9. Set REMOTE Switch to SLAVE. The SLAVE unit is now set up for control by the MASTER unit. If desired, the display annunciators can be observed to determine the progress of the MASTER unit. The following annunciators indicate the mode of the MASTER unit:

LEVEL & FREQUENCY	DBM
MESSAGE CKT NOISE	DBRN
NOISE-WITH-TONE	DBRN and RCV HZ
SIGNAL-TO-NOISE	DB
IMPULSE NOISE	COUNTS
ENVELOPE DELAY	MICRO SEC
PHASE JITTER	DEGREES and RCV HZ

LEVEL AND FREQUENCY MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS TEST FREQUENCIES TO SLAVE. SLAVE MEASURES RECEIVED dB OR dBm LEVELS AND TRANSMITS DATA TO MASTER DISPLAY ON OPPOSITE CIRCUIT.
SLAVE TO MASTER
MASTER TRANSMITS COMMANDS TO SLAVE TO TRANSMIT DESIRED TEST FREQUENCIES. MASTER MEASURES AND DISPLAYS RECEIVED dB OR dBm LEVELS.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

LEVEL AND FREQUENCY MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to TRMT.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. If SF signaling units are used in the network under test, set NO SF SKIP – SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
6. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

8. Set DISPLAY Switch to RCV.
9. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

10. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.

1000 HZ LOSS MEASUREMENT

11. Observe MASTER generated TRMT HZ (nominally 1004 Hz) in right display. Observe DBM level received by SLAVE unit on left display.

ATTENUATION DISTORTION MEASUREMENT

12. Momentarily hold down LEVEL ZERO Switch. This establishes a 0 dB reference at the reference frequency (1004 Hz).
13. Transmit desired test frequencies using TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control. Observe MASTER generated TRMT HZ in right display and DB level received by SLAVE unit in left display at each test frequency. +DB indicates more loss and –DB indicates less loss, relative to the reference frequency.

SLAVE TO MASTER DIRECTION

14. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.

1000 HZ LOSS MEASUREMENT

15. Observe SLAVE generated by RCV HZ (nominally 1004 Hz) in right display. Observe DBM level received by MASTER unit in left display.

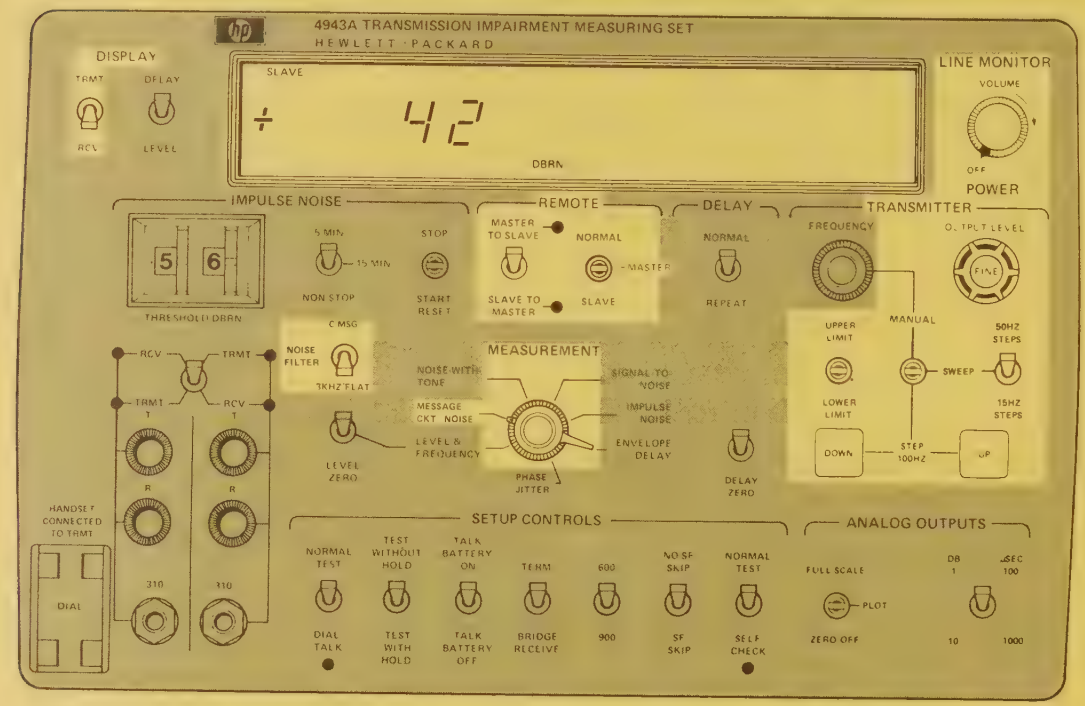
ATTENUATION DISTORTION MEASUREMENT

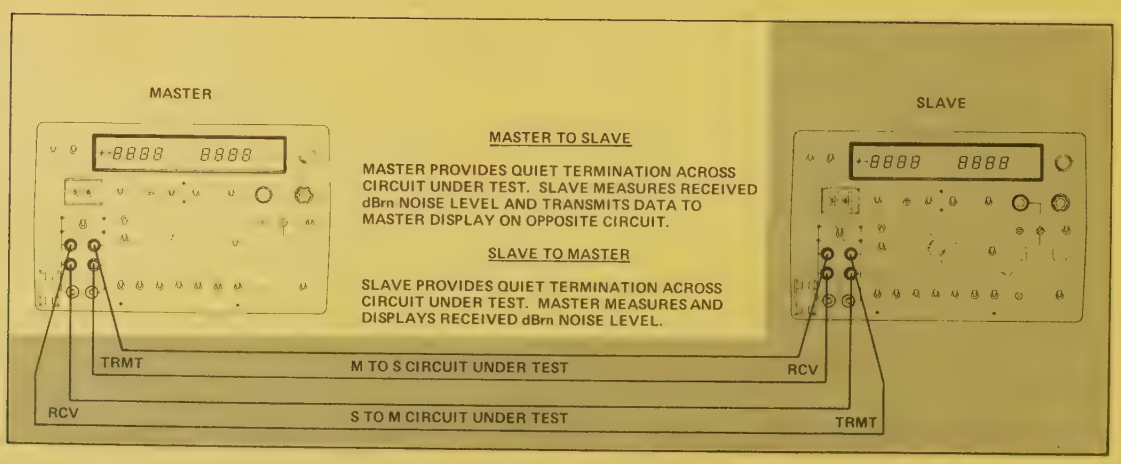
16. Momentarily hold down LEVEL ZERO Switch. This establishes a 0 dB reference at the reference frequency (1004 Hz).
17. Command SLAVE unit to transmit desired test frequencies by operating MASTER unit TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control. Observe SLAVE generated RCV HZ in right display and DB level received by MASTER unit in left display at each test frequency. +DB indicates more loss and –DB indicates less loss, relative to the reference frequency.

NOTE

Attenuation Distortion measurements can also be made in absolute dBm. The test set is automatically in the dBm mode until the LEVEL ZERO Switch is operated. To return the test set to the dBm mode, momentarily rotate MEASUREMENT Switch to another position, then back to LEVEL & FREQUENCY again.

MESSAGE CIRCUIT NOISE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER PROVIDES QUIET TERMINATION ACROSS CIRCUIT UNDER TEST. SLAVE MEASURES RECEIVED dBrn NOISE LEVEL AND TRANSMITS DATA TO MASTER DISPLAY ON OPPOSITE CIRCUIT.
SLAVE TO MASTER
SLAVE PROVIDES QUIET TERMINATION ACROSS CIRCUIT UNDER TEST. MASTER MEASURES AND DISPLAYS RECEIVED dBrn NOISE LEVEL.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

MESSAGE CIRCUIT NOISE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to LEVEL & FREQUENCY.
3. Set DISPLAY Switch to TRMT.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. Adjust transmit frequency to 1004 Hz using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set MEASUREMENT Switch to MESSAGE CKT NOISE.
8. Set NOISE FILTER Switch to select C-MSG weighted filter or 3 KHZ FLAT weighted filter, as desired.
9. Set DISPLAY Switch to RCV.
10. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

11. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on with 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
12. Observe DBRN noise level received by SLAVE unit in left display. NOTE: "H-10" in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

13. In order to perform a Single Frequency Interference Check in the Master to Slave Direction, the SLAVE unit must turn on his LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. He should listen for any predominant tone which will indicate a potential single frequency interference problem.

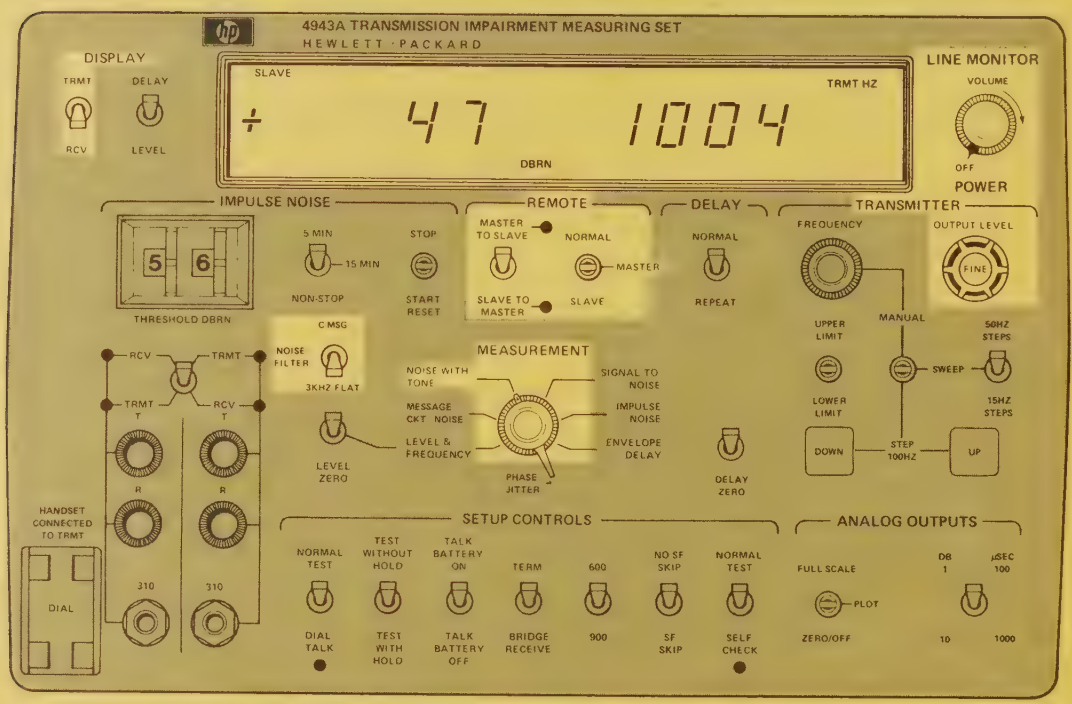
SLAVE TO MASTER DIRECTION

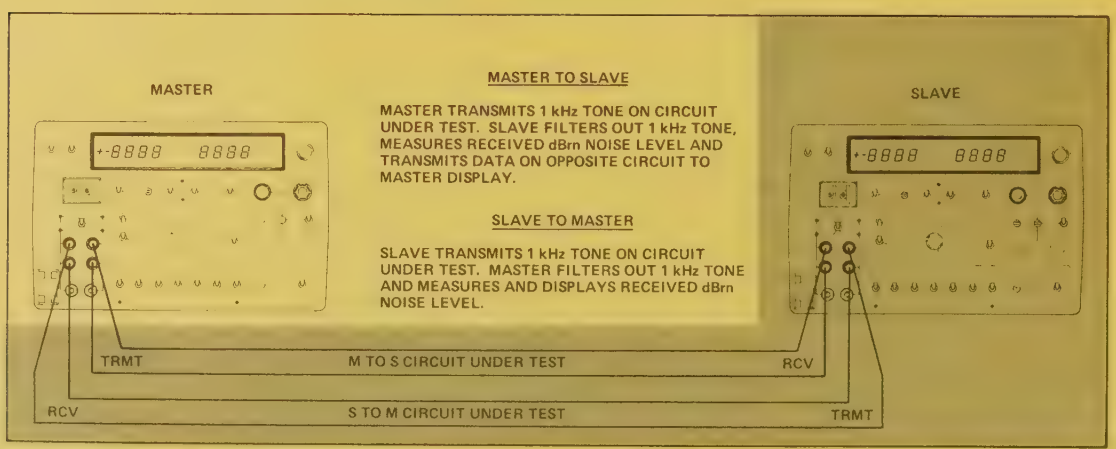
14. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
15. Observe DBRN noise level received by MASTER unit in left display. NOTE: A "−" sign in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

16. Adjust VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

NOISE-WITH-TONE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. SLAVE FILTERS OUT 1 kHz TONE, MEASURES RECEIVED dBrn NOISE LEVEL AND TRANSMITS DATA ON OPPOSITE CIRCUIT TO MASTER DISPLAY.
SLAVE TO MASTER
SLAVE TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. MASTER FILTERS OUT 1 kHz TONE AND MEASURES AND DISPLAYS RECEIVED dBrn NOISE LEVEL.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

NOISE-WITH-TONE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to NOISE-WITH-TONE.
3. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
4. Set DISPLAY Switch to TRMT.
5. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set DISPLAY Switch to RCV.
8. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

9. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
10. Observe MASTER generated TRMT HZ (1004 Hz) in right display. Observe DBRN noise level received by SLAVE unit in left display. NOTE: "H-10" in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

11. In order to perform a Single Frequency Interference Check in the Master to Slave Direction, the SLAVE unit must turn on his LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. He should listen for any predominant tone which will indicate a potential single frequency interference problem.

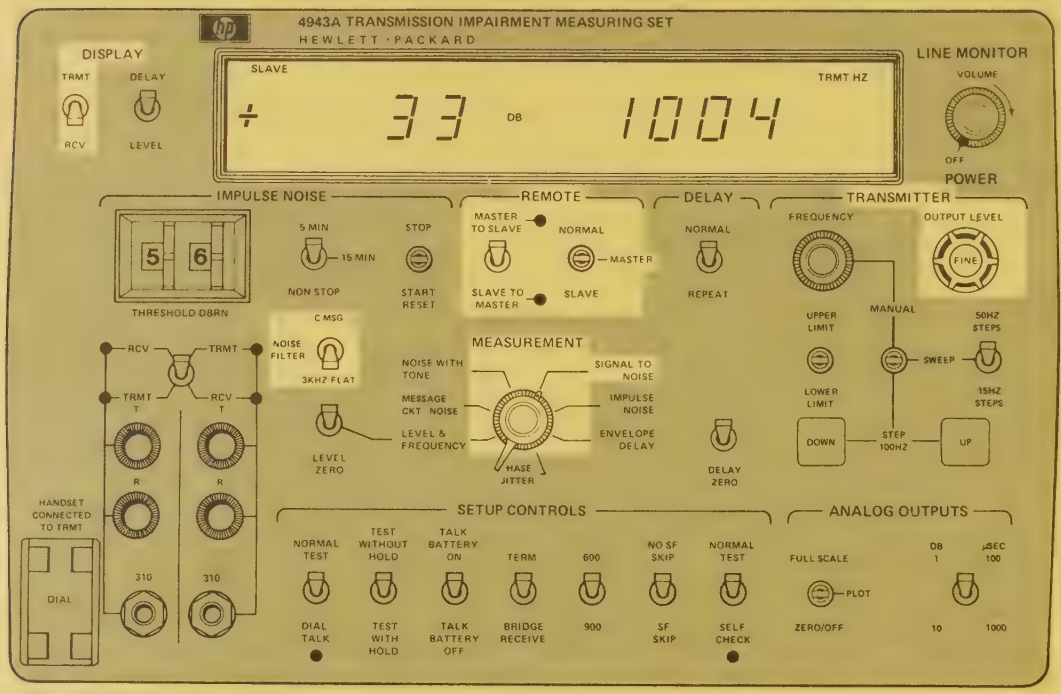
SLAVE TO MASTER DIRECTION

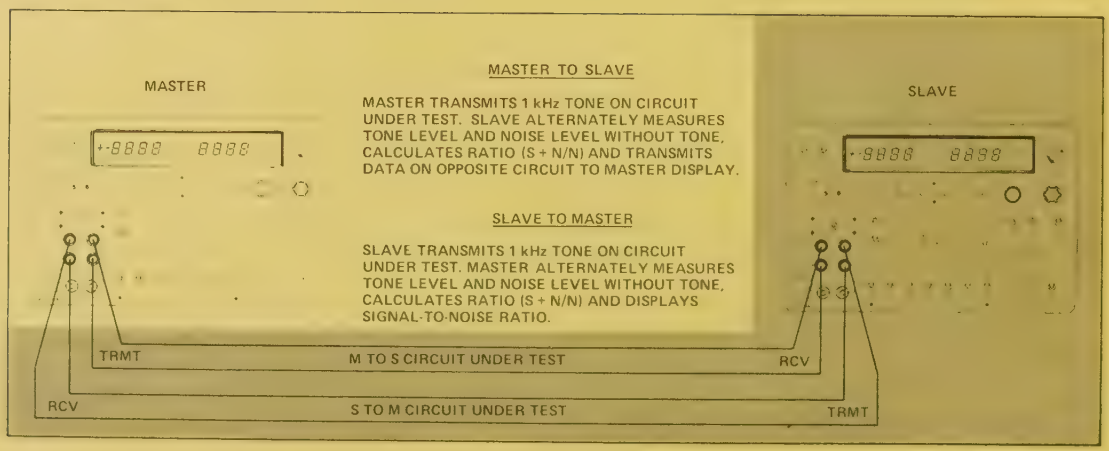
12. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
13. Observe SLAVE generated RCV HZ (1004 Hz) in right display. Observe DBRN noise level received by MASTER unit in left display. NOTE: A "−" sign in left display indicates underrange (<20 DBRN).

SINGLE FREQUENCY INTERFERENCE CHECK

14. Adjust VOLUME control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

SIGNAL-TO-NOISE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. SLAVE ALTERNATELY MEASURES TONE LEVEL AND NOISE LEVEL WITHOUT TONE, CALCULATES RATIO (S + N/N) AND TRANSMITS DATA ON OPPOSITE CIRCUIT TO MASTER DISPLAY.
SLAVE TO MASTER
SLAVE TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. MASTER ALTERNATELY MEASURES TONE LEVEL AND NOISE LEVEL WITHOUT TONE, CALCULATES RATIO (S + N/N) AND DISPLAYS SIGNAL-TO-NOISE RATIO.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

SIGNAL-TO-NOISE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to SIGNAL-TO-NOISE.
3. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
4. Set DISPLAY Switch to TRMT.
5. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set DISPLAY Switch to RCV.
8. Set REMOTE Switch to MASTER.

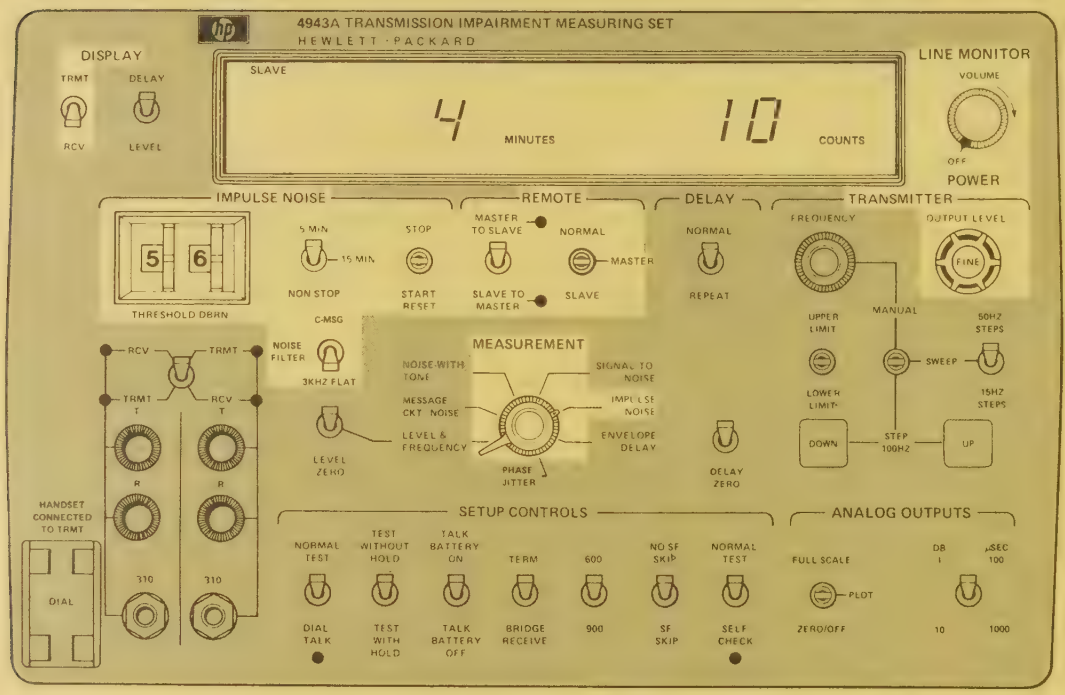
MASTER TO SLAVE DIRECTION

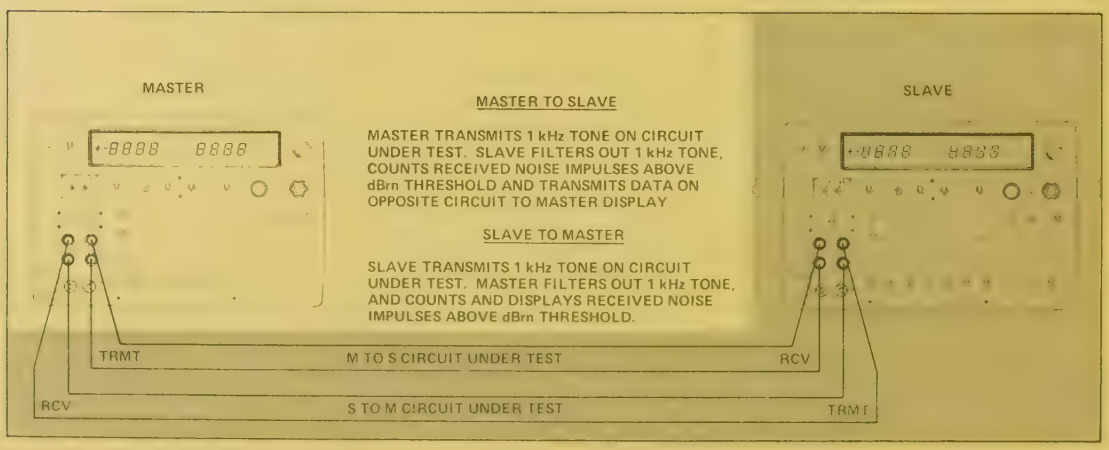
9. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
10. Observe MASTER generated TRMT HZ (1004 Hz) in right display. Observe DB signal-to-noise ratio (S+N/N) received by SLAVE unit in left display. NOTE: "H-10" in left display indicates underrange (noise <20 DBRN).

SLAVE TO MASTER DIRECTION

11. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
12. Observe SLAVE generated RCV HZ (1004 Hz) in right display. Observe DB signal-to-noise ratio (S+N/N) received by MASTER unit in left display. NOTE: A "−" sign in left display indicates underrange (noise <20 DBRN).

IMPULSE NOISE MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. SLAVE FILTERS OUT 1 kHz TONE, COUNTS RECEIVED NOISE IMPULSES ABOVE dBrn THRESHOLD AND TRANSMITS DATA ON OPPOSITE CIRCUIT TO MASTER DISPLAY
SLAVE TO MASTER
SLAVE TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. MASTER FILTERS OUT 1 kHz TONE, AND COUNTS AND DISPLAYS RECEIVED NOISE IMPULSES ABOVE dBrn THRESHOLD.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

IMPULSE NOISE MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to IMPULSE NOISE.
3. Set NOISE FILTER Switch to select C-MSG weighted filter or 3KHZ FLAT weighted filter, as desired.
4. Set DISPLAY Switch to TRMT.
5. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
6. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

7. Set DISPLAY Switch to RCV.
8. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

9. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
10. Set IMPULSE NOISE Switch to desired count interval (5 MIN, 15 MIN, or NON-STOP).
11. Verify that SLAVE unit IMPULSE NOISE Thumbwheel Switches have been set up to desired DBRN THRESHOLD. (This should have been performed during his SLAVE SETUP procedure).
12. Momentarily hold down and release IMPULSE NOISE STOP-START/RESET Switch to START/RESET position. Observe that IN PROCESS Annunciator comes on.
13. Left display indicates count time (in minutes) remaining in 5 MIN and 15 MIN modes. Elapsed time is indicated for NON-STOP mode.
14. Observe that IN PROCESS Annunciator goes out at completion of 5 MIN or 15 MIN interval. Observe impulse noise COUNTS received by SLAVE unit on right display.
15. If NON-STOP mode is used, momentarily hold up and release IMPULSE NOISE STOP-START/RESET Switch to STOP position at end of desired counting interval. Observe impulse noise COUNTS received by SLAVE unit in right display.

SINGLE FREQUENCY INTERFERENCE CHECK

16. In order to perform a Single Frequency Interference Check in the Master to Slave Direction, the SLAVE unit must turn on his LINE MONITOR by adjusting VOLUME Control until desired loudness is obtained in speaker. He should listen for any predominant tone which will indicate a potential single frequency interference problem.

(continued on next page)

SLAVE TO MASTER DIRECTION

17. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
18. Set IMPULSE NOISE Switch to desired count interval (5 MIN, 15 MIN, or NON-STOP).
19. Set IMPULSE NOISE Thumbwheel Switches to desired DBRN THRESHOLD.
20. Momentarily hold down and release IMPULSE NOISE STOP-START/RESET Switch to START/RESET position. Observe that IN PROCESS Annunciator comes on.
21. Left Display indicates count time (in minutes) remaining in 5 MIN and 15 MIN modes. Elapsed time is indicated for NON-STOP mode.
22. Observe that IN PROCESS Annunciator goes out at completion of 5 MIN or 15 MIN interval. Observe impulse noise COUNTS received by MASTER unit in right display.
23. If NON-STOP mode is used, momentarily hold up and release IMPULSE NOISE STOP-START/RESET Switch to STOP position at end of desired counting interval. Observe impulse noise COUNTS received by MASTER unit in right display.

SINGLE FREQUENCY INTERFERENCE CHECK

24. Adjust VOLUME Control until desired loudness is obtained in speaker. Listen for any predominant tone which will indicate a potential single frequency interference problem.

NOTE

Count can be reset to zero and restarted at any time by momentarily holding switch to START/RESET position. Count can also be stopped at any time by momentarily holding switch to STOP position, however, count must be restarted at zero counts.

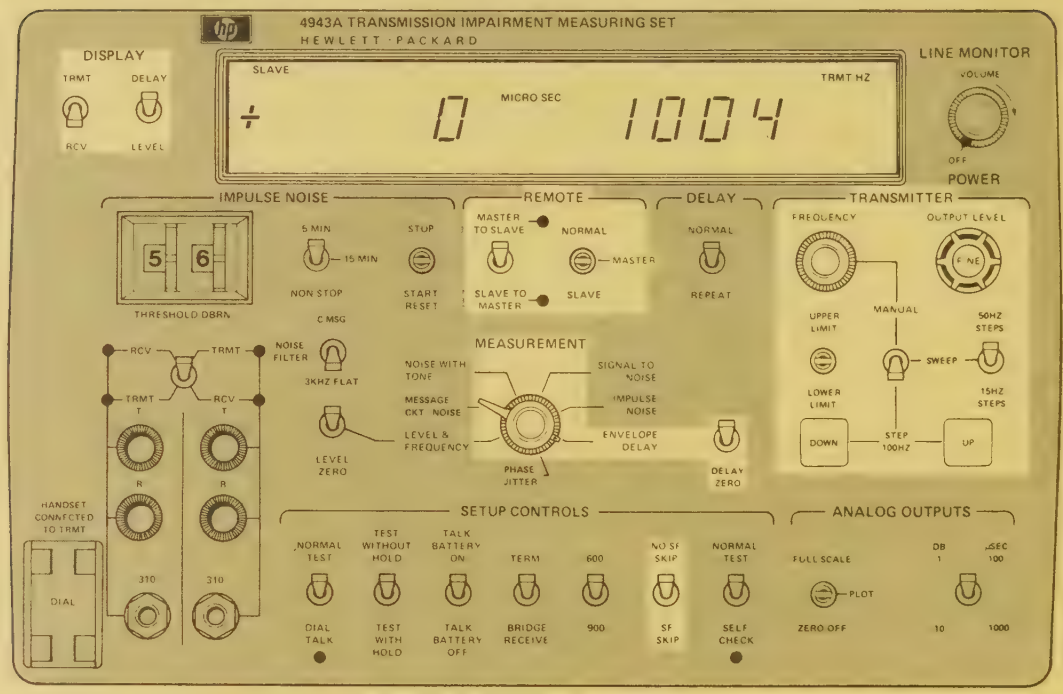
NOTE

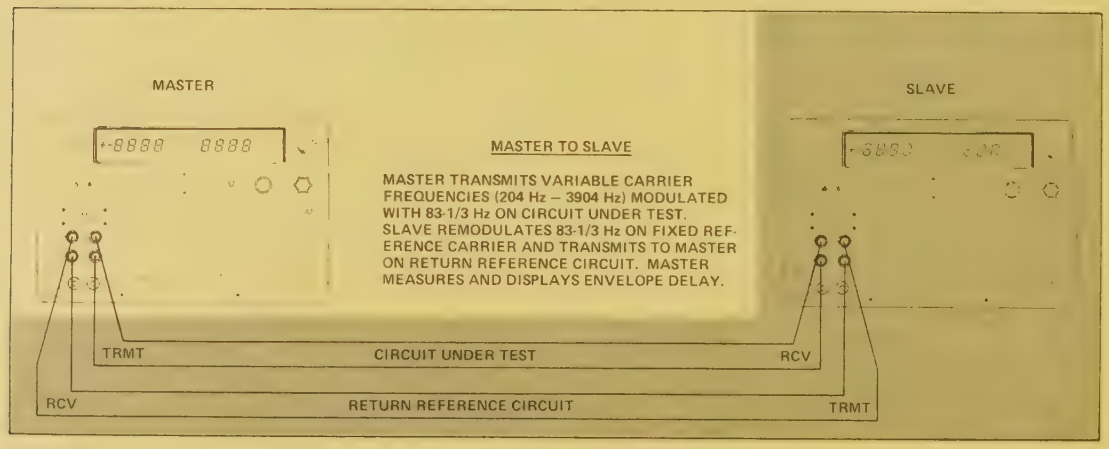
The right display has a maximum capacity of 9999 COUNTS. If this capacity is exceeded, the display will indicate "H-12" to indicate "accumulator overflow condition".

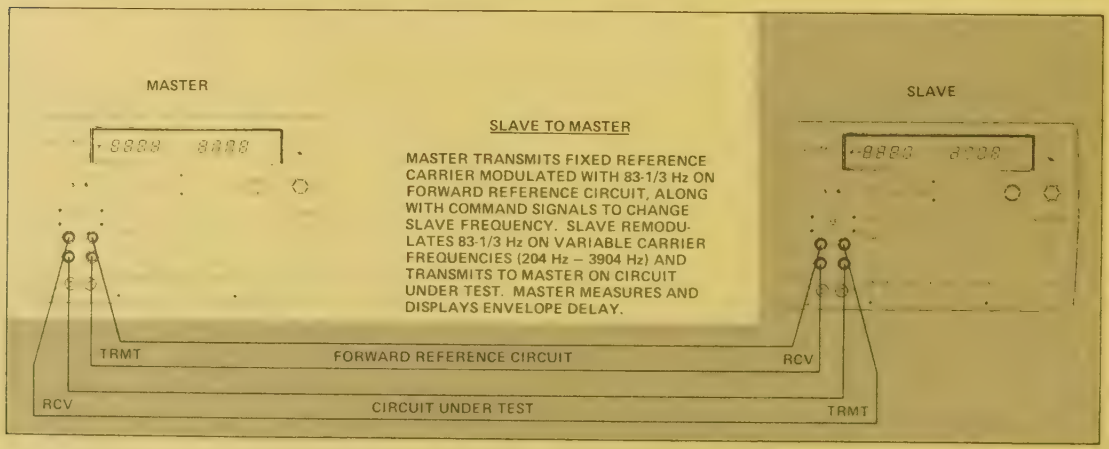
NOTE

If a circuit drop-out exceeding one second occurs at any time during the counting interval, a condition code "H-14" will be displayed. If this occurs, it will be necessary to re-establish control over the SLAVE unit by momentarily throwing the REMOTE Switch to NORMAL, then back to MASTER again.

ENVELOPE DELAY MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS VARIABLE CARRIER FREQUENCIES (204 Hz – 3904 Hz) MODULATED WITH 83-1/3 Hz ON CIRCUIT UNDER TEST. SLAVE REMODULATES 83-1/3 Hz ON FIXED REFERENCE CARRIER AND TRANSMITS TO MASTER ON RETURN REFERENCE CIRCUIT. MASTER MEASURES AND DISPLAYS ENVELOPE DELAY.
TRMT
CIRCUIT UNDER TEST
RCV
RCV
RETURN REFERENCE CIRCUIT
TRMT


MASTER
SLAVE
SLAVE TO MASTER
MASTER TRANSMITS FIXED REFERENCE CARRIER MODULATED WITH 83-1/3 Hz ON FORWARD REFERENCE CIRCUIT, ALONG WITH COMMAND SIGNALS TO CHANGE SLAVE FREQUENCY. SLAVE REMODULATES 83-1/3 Hz ON VARIABLE CARRIER FREQUENCIES (204 Hz – 3904 Hz) AND TRANSMITS TO MASTER ON CIRCUIT UNDER TEST. MASTER MEASURES AND DISPLAYS ENVELOPE DELAY.
TRMT
FORWARD REFERENCE CIRCUIT
RCV
RCV
CIRCUIT UNDER TEST
TRMT

ENVELOPE DELAY MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to ENVELOPE DELAY.
3. Set DISPLAY Switches to TRMT and LEVEL.
4. Set TRANSMITTER Switch to STEP 100 HZ.
5. If SF signaling units are used in the network under test, set NO SF SKIP – SF SKIP Switch to SF SKIP. This mode automatically blanks the transmitter output so that frequencies between 2450 Hz and 2750 Hz cannot be transmitted.
6. Adjust transmit frequency to reference frequency (e.g., 1804 Hz, or frequency of minimum delay) using TRANSMITTER UP-DOWN Pushbuttons. Observe TRMT HZ in right display.
7. Adjust OUTPUT LEVEL Control for "Data Level". Observe DBM in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is –16 dB, the Data Level would be –29 dBm. Therefore, an output level of –29 dBm would be applied in this case.

8. Set DISPLAY Switch to RCV.
9. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION (RETURN REFERENCE)

10. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
11. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

NOTE

This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

12. Observe MASTER generated TRMT HZ in right display. Select desired test frequencies using TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control.
13. At each test frequency, observe ± MICRO SEC envelope delay received by SLAVE unit in left display. If readings vary, observe for an arithmetic mean (average).

SLAVE TO MASTER DIRECTION (FORWARD REFERENCE)

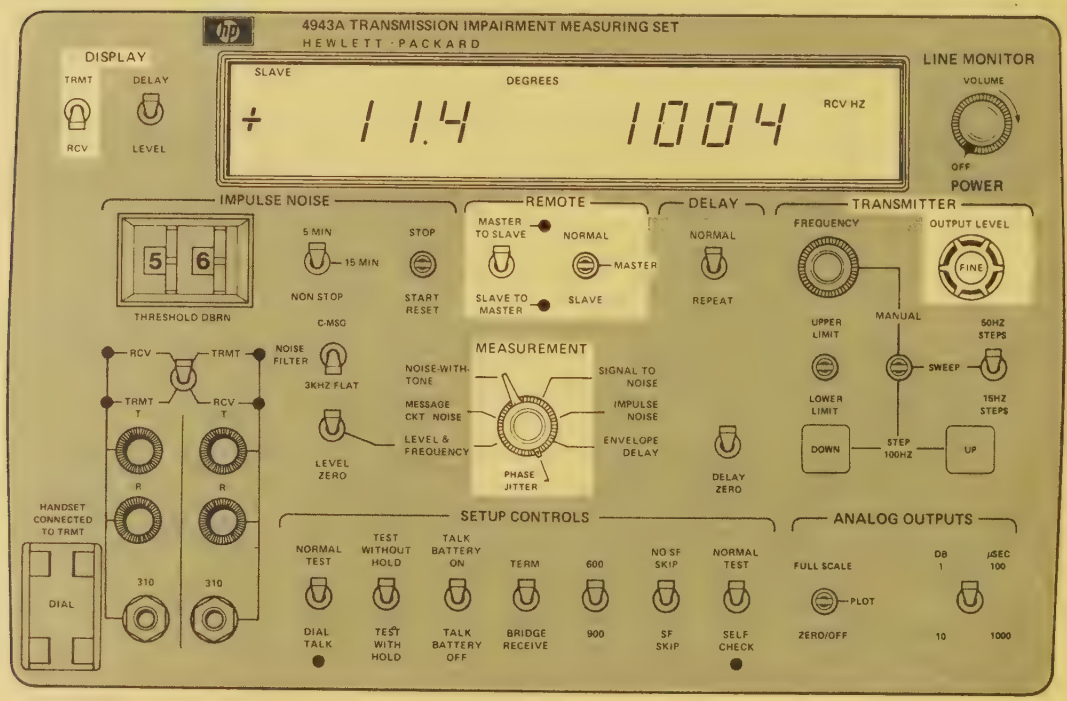
14. Perform MASTER SETUP steps 1-9.
15. Set REMOTE Switch SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that the MASTER unit has achieved control over the SLAVE unit.
16. Observe ± MICRO SEC in left display. This reading may be very erratic for a few seconds until the loop stabilizes. When the display stabilizes so that only the units and tens digits are changing, momentarily hold down and release DELAY ZERO Switch.

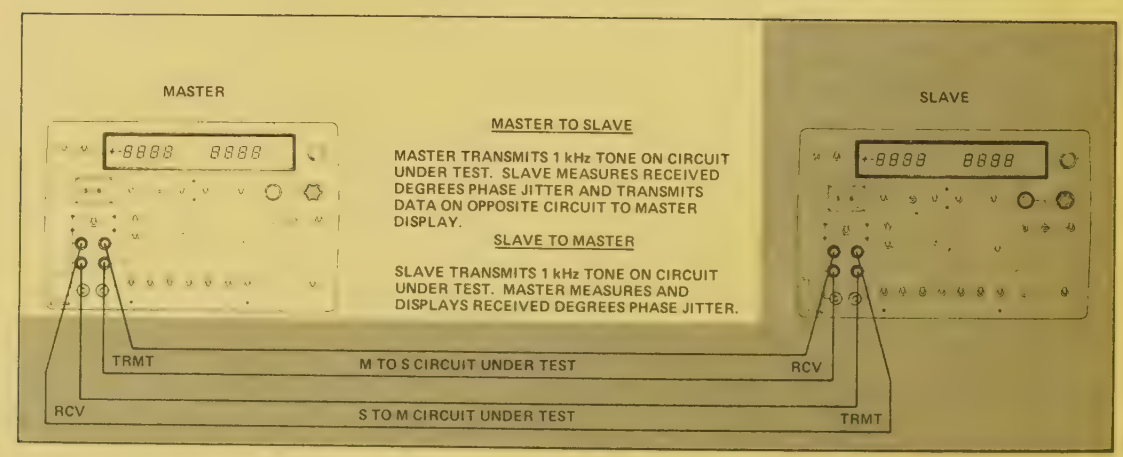
NOTE

This establishes a reference zero at the reference frequency. Typically, this reading will vary ±5 MICRO SEC. However, on very noisy circuits, the variation may be greater. A valid reference zero is established if these variations are evenly distributed above and below zero microseconds.

17. Observe SLAVE generated RCV HZ in right display. Command SLAVE unit to transmit desired test frequencies by operating MASTER unit TRANSMITTER UP-DOWN Pushbuttons or MANUAL FREQUENCY Control.
18. At each test frequency, observe ± MICRO SEC envelope delay received by MASTER unit in left display. If readings vary, observe for an arithmetic mean (average).

PHASE JITTER MASTER OPERATION




MASTER
SLAVE
MASTER TO SLAVE
MASTER TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. SLAVE MEASURES RECEIVED DEGREES PHASE JITTER AND TRANSMITS DATA ON OPPOSITE CIRCUIT TO MASTER DISPLAY.
SLAVE TO MASTER
SLAVE TRANSMITS 1 kHz TONE ON CIRCUIT UNDER TEST. MASTER MEASURES AND DISPLAYS RECEIVED DEGREES PHASE JITTER.
TRMT
M TO S CIRCUIT UNDER TEST
RCV
RCV
S TO M CIRCUIT UNDER TEST
TRMT

PHASE JITTER MASTER OPERATION

MASTER SETUP

1. Set REMOTE Switch to NORMAL.
2. Set MEASUREMENT Switch to PHASE JITTER.
3. Set DISPLAY Switch to TRMT.
4. Observe TRMT HZ in right display. Verify that 1004 Hz is being transmitted.
5. Adjust OUTPUT LEVEL control for "Data Level". Observe DBM level in left display.

DATA LEVEL

All transmission measurements should be made at Data Level. The Data Level for data circuits is a power 13 dB below the Transmission Level Point (TLP). For example, if the TLP is −16 dB, the Data Level would be −29 dBm. Therefore, an output level of −29 dBm would be applied in this case.

6. Set DISPLAY Switch to RCV.
7. Set REMOTE Switch to MASTER.

MASTER TO SLAVE DIRECTION

8. Set REMOTE Switch to MASTER TO SLAVE. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that MASTER unit has achieved control over SLAVE unit. Observe that SLAVE annunciator is on, indicating that measurements will be made by SLAVE unit.
9. Observe MASTER generated TRMT HZ (1004 HZ) in right display. Observe DEGREES phase jitter received by SLAVE unit in left display. If readings vary, observe for an arithmetic mean (average).

SLAVE TO MASTER DIRECTION

10. Set REMOTE Switch to SLAVE TO MASTER. Wait until associated dot light illuminates before proceeding. This dot light should come on within 10 seconds. It indicates that MASTER unit has achieved control over SLAVE unit.
11. Observe SLAVE generated RCV HZ (1004 HZ) in right display. Observe DEGREES phase jitter in left display. If readings vary, observe for an arithmetic mean (average).

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AUSTRALIA
Hewlett-Packard Australia Pty. Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
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Tel: 38973
Telex: 33569
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JAPAN
Yokogawa-Hewlett-Packard Ltd
Ohashi Building
59-1 Yoyogi 1-Chome
Shibuya-ku, **Tokyo** 151
Tel: 03-370-2281/92
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg., 4th Floor
4-20, Nishinakajima 5-chome
Yodogawa-ku, Osaka-shi
Osaka 532
Tel: 06-304-6021

Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
24 Kami Sasajima-cho
Nakamura-ku, **Nagoya**, 450
Tel: (052) 571-5171

Yokogawa-Hewlett-Packard Ltd.
Tanigawa Building
2-24-1 Tsuruya-cho
Kanagawa-ku
Yokohama, 221
Tel: 045-312-1252
Telex: 382-3204 YHP YOK

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsu Building
105, Chome-1,San-no-maru
Mito, Ibaragi 310
Tel: 0292-25-7470

Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho, 1-chome
Atsugi, Kanagawa 243
Tel: 0462-24-0452

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi
Hachijuni Building
4th Floor
3-4, Tsukuba
Kumagaya, Saitama 360
Tel: 0485-24-6563

KENYA
Technical Engineering Services(E.A.)Ltd.,
P.O. Box 18311
Nairobi
Tel: 557726/556762
Cable: PROTON

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P.O. Box 19012
Nairobi Airport
Nairobi
Tel: 336055/56
Telex: 22201/22301
Cable: INTAERIO Nairobi

KOREA
Samsung Electronics Co., Ltd.
20th Fl. Dongbang Bldg. 250, 2-KA
C.P.O. Box 2775
Taepyung-Ro, Chung-Ku
Seoul
Tel: (23) 6811
Telex: 22575
Cable: ELEKSTAR Seoul

MALAYSIA
Teknik Mutu Sdn. Bhd.
2 Lorong 13/6A
Section 13
Petaling Jaya,**Selangor**
Tel: 54994,54916
Telex: MA 37605

Protel Engineering
P.O. Box 1917
Lot 259, Satok Road
Kuching, **Sarawak**
Tel: 2400
Cable: PROTEL ENG

MOZAMBIQUE
A.N. Goncalves, Lta.
162, 1 Apt. 14 Av. D. Luis
Caixa Postal 107
Lourenco Marques
Tel: 27091, 27114
Telex: 6-203 NEGON Mo
Cable: NEGON

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
P.O. Box 9443
Courtenay Place
Wellington
Tel: 877-199
Telex: NZ 3839
Cable: HEWPACK Wellington

Hewlett-Packard (N.Z.) Ltd.
Pakuranga Professional Centre
267 Pakuranga Highway
Box 51092
Pakuranga
Tel: 569-651
Cable: HEWPACK Auckland

Analytical/Medical Only
Medical Supplies N.Z. Ltd.
Scientific Division
79 Carlton Gore Rd., Newmarket
P.O. Box 1234
Auckland
Tel: 75-289
Cable:DENTAL Auckland

Analytical/Medical Only
Medical Supplies N.Z. Ltd.
P.O. Box 1994
147-161 Tory St.
Wellington
Tel: 850-799
Telex: 3858
Cable: DENTAL, Wellington

Analytical/Medical Only
Medical Supplies N.Z. Ltd.
P.O. Box 309
239 Stanmore Road
Christchurch
Tel: 892-019
Cable: DENTAL, Christchurch

Analytical/Medical Only
Medical Supplies N.Z. Ltd.
303 Great King Street
P.O. Box 233
Dunedin
Tel: 88-817
Cable: DENTAL, Dunedin

NIGERIA
The Electronics Instrumentations Ltd.
N68/770 Oyo Road
Oluseun House
P.M.B. 5402
Ibadan
Tel: 61577
Telex: 31231 TEIL Nigeria
Cable: THETEIL Ibadan

The Electronics Instrumentations Ltd.
144 Agege Motor Road, Mushin
P.O. Box 6645
Lagos
Cable: THETEIL Lagos

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Mushko & Company, Ltd.
Oosman Chambers
Abdullah Haroon Road
Karachi-3
Tel: 511027, 512927
Telex: 2894
Cable: COOPERATOR Karachi

Mushko & Company, Ltd.
38B, Satellite Town
Rawalpindi
Tel: 41924
Cable: FEMUS Rawalpindi

PHILIPPINES
The Online Advanced Systems Corporation
8th Floor, Filcapital Bldg.
Ayala Avenue
Makati, Metro**Manila**
Tel: 85-35-81, 85-34-91
Telex: 3274 ONLINE

RHODESIA
Field Technical Sales
45 Kelvin Road North
P.O. Box 3458
Salisbury
Tel: 705231 (5 lines)
Telex: RH 4122

SINGAPORE
Hewlett-Packard Singapore (Pte.) Ltd.
1150 Depot Road
Alexandra P.O. Box 58
Singapore 4
Tel: 270-2355
Telex: HPSG RS 21486
Cable: HEWPACK, Singapore

SOUTH AFRICA
Hewlett-Packard South Africa (Pty.) Ltd.
Private Bag Wendywood
Sandton, Transvaal 2144
Hewlett-Packard Centre
Daphne Street, Wendywood,
Sandton, Transvaal 2144
Tel: 802-10408
Telex: 8-4782
Cable: HEWPACK JOHANNESBURG

Service Department
Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 39325
Gramley, Sandton, 2018
451 Wynberg Extension 3,
Sandton, 2001
Tel: 636-8188/9
Telex: 8-2391

Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 120
Howard Place, Cape Province, 7450
Pine Park Centre, Forest Drive,
Pinelands, Cape Province, 7405
Tel: 53-7955 thu 9
Telex: 57-0006

Service Department
Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 37099
Overport, Durban 4067
Braby House
641 Ridge Road
Durban, 4001
Tel: 88-7478
Telex: 6-7954

TAIWAN
Hewlett-Packard Far East Ltd.,
Taiwan Branch
39 Chung Hsiao West Road
Sec. 1, 7th Floor
Taipei
Tel: 3819160-4
Cable: HEWPACK TAIPEI

Hewlett-Packard Far East Ltd.
Taiwan Branch
68-2, Chung Cheng 3rd. Road
Kaohsiung
Tel: (07) 242318-Kaohsiung

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Medical Only
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P.O. Box 861
Dar es Salaam
Tel: 21251 Ext. 265
Telex: 41030

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UNIMESA Co., Ltd.
Elcom Research Building
2538 Sukumvit Ave.
Bangkok
Tel: 3932387, 3930338
Cable: UNIMESA Bangkok

UGANDA
Medical Only
International Aeradio(E.A.), Ltd.,
P.O. Box 2577
Kampala
Tel: 54388
Cable: INTAERIO Kampala

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R.J. Tilbury (Zambia) Ltd.
P.O. Box 2792
Lusaka
Tel: 73793
Cable: ARJAYTEE, Lusaka

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3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

CANADA

ALBERTA
Hewlett-Packard (Canada) Ltd.
11620A - 168th Street
EdmontonT5M 3T9
Tel: (403) 452-3670
TWX: 610-831-2431 EDTH

Hewlett-Packard (Canada) Ltd.
210,7220 Fisher St. S.E.
Calgary T2H 2H8
Tel: (403) 253-2713
Twx: 610-821-6141

BRITISH COLUMBIA
Hewlett-Packard (Canada) Ltd.
837 E. Cordova Street
Vancouver V6A 3R2
Tel: (604) 254-0531
TWX: 610-922-5059 VCR

MANITOBA
Hewlett-Packard (Canada) Ltd.
513 Century St.
St. James
Winnipeg R3H 0L8
Tel: (204) 786-7581
TWX: 610-671-3531

NOVA SCOTIA
Hewlett-Packard (Canada) Ltd.
800 Windmill Road
Dartmouth B3B 1L1
Tel: (902) 469-7820
TWX: 610-271-4482 HFX

ONTARIO
Hewlett-Packard (Canada) Ltd.
1020 Morrison Dr.
Ottawa K2H 8K7
Tel: (613) 820-6483
TWX: 610-563-1636

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
Mississauga L4V 1M8
Tel: (416) 678-9430
TWX: 610-492-4246

QUEBEC
Hewlett-Packard (Canada) Ltd.
275 Hymus Blvd.
Pointe Claire H9R 1G7
Tel: (514) 697-4232
TWX: 610-422-3022
TLX: 05-821521 HPCL

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CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina S.A.
Av. Leandro N. Alem 822 - 12
1001**Buenos Aires**
Tel: 31-6063,4,5,6 and 7
Telex: Public Booth N°9
Cable: HEWPACK ARG

BOLIVIA
Casa Kavlin S.A.
Calle Potosi 1130
P.O. **B**ox 500
La Paz
Tel: 41530,53221
Telex: CWC BX 5298,ITT 3560082
Cable: KAVLIN

BRAZIL
Hewlett-Packard do Brasil I.e.C. Ltda.
Avenida Rio Negro, 980
Alphaville
06400**Barueri** SP
Tel: 429-2148/9,429-2118/9

Hewlett-Packard do Brasil I.e.C. Ltda.
Rua Padre Chagas, 32
90000-**Pôrto Alegre**-RS
Tel: (0512) 22-2998, 22-5621
Cable: HEWPACK Potto Alegre

Hewlett-Packard do Brasil I.E.C. Ltda.
Rua Siqueira Campos, 53
Copacabana
20000-**Rio de Janeiro**
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Telex: 39-212-1905 HEWP-BR
Cable: HEWPACK
Rio de Janeiro

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Calcagni y Metcalfe Ltda.
Alameda 580-Of. 807
Casilla 2118
Santiago, 1
Tel: 398613
Telex: 3520001 CALMET
Cable: CALMET Santiago

COLOMBIA
Instrumentación
Henrik A. Langebaek & Kier S.A.
Carrera 7 No. 48-75
Apartado Aéreo 6287
Bogota, D.E.
Tel: 69-88-77
Cable: AARIS Bogotá
Telex: 044-400

COSTA RICA
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Apartado 10159
San José
Tel: 21-86-13
Cable: GALGUR San José

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Quito
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EL SALVADOR
Instrumentacion y Procesamiento Electronico de el Salvador
Bulevar de los Heroes II-48
San Salvador
Tel: 252787

GUATEMALA
IPESA
Avenida La Reforma 3-48,
Zona 9
Guatemala City
Tel: 63627, 64786
Telex: 4192 Teletro Gu

MEXICO
Hewlett-Packard Mexicana, S.A. de C.V.
Torres Adalid No. 21, 11 Piso
Col. del Valle
Mexico 12, D.F.
Tel: (905) 543-42-32
Telex: 017-74-507

Hewlett-Packard Mexicana, S.A. de C.V.
Ave. Constitución No. 2184
Monterrey, N.L.
Tel: 48-71-32, 48-71-84
Telex: 038-843

NICARAGUA
Roberto Terán G.
Apartado Postal 689
Edificio Terán
Managua
Tel: 25114, 23412,23454
Cable: ROTERAN Managua
Calculators Only
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Ciudad Jardin D-1
Managua
Tel: 24108

PANAMA
Electrónico Balboa, S.A.
P.O. Box 4929
Calle Samuel Lewis
Cuidad de Panama
Tel: 64-2700
Telex: 3431103 Curunda, Canal Zone
Cable: ELECTRON Panama

PARAGUAY
Z.J. Melamed S.R.L.
División: Aparatos y Equipos Médicos
División: Aparatos y Equipos Cientificos y de Investigación
P.O. Box 676
Chile-482, Edificio Victoria
Asunción
Tel: 91-271, 91-272
Cable: RAMEL

PERU
Compañía Electro Médica S.A.
Los Flamencos 145
San Isidro Casilla 1030
Lima 1
Tel: 41-4325
Cable: ELMED Lima

PUERTO RICO
Hewlett-Packard Inter-Americas
Puerto Rico Branch Office
Calle 272
No. 203 Urb. Country Club
Carolina 00924
Tel: (809) 762-7255
Telex: 345 0514

URUGUAY
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel: 40-3102
Cable: RADIUM Montevideo

VENEZUELA
Hewlett-Packard de Venezuela C.A.
P.O. Box 50933
Caracas 105
Los Ruices Norte
3a Transversal
Edificio Segre
Caracas 107
Tel: 35-00-11 (20 lines)
Telex: 25146 HEWPACK
Cable: HEWPACK Caracas

FOR AREAS NOT LISTED, CONTACT:
Hewlett-Packard Inter-Americas
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1260
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

EUROPE, NORTH AFRICA AND MIDDLE EAST

AUSTRIA
Hewlett-Packard Ges.m.b.H.
Handelskai 52
P.O. box 7
A-1205 **Vienna**
Tel: (0222) 351621 to 27
cable: HEWPAK Vienna
Telex: 75923 hewpak a

BELGIUM
Hewlett-Packard Benelux
S.A./N.V.
Avenue de Col-Vert, 1,
(Groenkraaglaan)
B-1170 **Brussels**
Tel: (02) 672 22 40
Cable: PALOBEN Brussels
Telex: 23 494 paloben bru

CYPRUS
Kypronics
19, Gregorios & Xenopoulos Rd
P.O. Box 1152
CY-**Nicosia**
Tel: 45628/29
Cable: KYPRONICS PANDEHIS
Telex: 3018

CZECHOSLOVAKIA
Vyvojova a Provozni Zakladna
Vyzkumnych Ustavu v Bechovicich
CSSR-25097 **Bechovice u Prahy**
Tel: 89 93 41
Telex: 121333

Institute of Medical Bionics
Vyskumny Ustav Lekarskej Bioniky
Jedlova 6
CS-88346 **Bratislava-Kramare**
Tel: 44-551/45-541

DDR
Entwicklungslabor der TU Dresden
Forschungsinstitut Meinsberg
DDR-7305
Waldheim/Meinsberg
Tel: 37 667
Telex: 112145

Export Contact AG Zuerich
Guenther Forgber
Schlegelstrasse 15
1040 **Berlin**
Tel: 42-74-12
Telex: 111889

DENMARK
Hewlett-packard A/S
Datavej 52
DK-3460 **Birkerod**
Tel: (02) 81 66 40
Cable: HEWPACK AS
Telex: 166 40 hpas

Hewlett-Packard A/S
Navervej 1
DK-8600 **Silkeborg**
Tel: (06) 82 71 66
Telex: 166 40 hpas
Cable: HEWPACK AS

FINLAND
Hewlett-Packard OY
Nahkahuosuntie 5
P.O. Box 6
SF-00211 **Helsinki** 21
Tel: (90) 6923031
Cable: HEWPACKOY Helsinki
Telex: 12-1563 HEWPA SF

FRANCE
Hewlett-Packard France
Quartier de Courtaboeuf
Boite Postale No. 6
F-91401 **Orsay** Cedex
Tel: (1) 907 78 25
Cable: HEWPACK Orsay
Telex: 600048

Hewlett-Packard France
Agency Régionale
Le Saquin
Chemin des Mouilles
B.P. 162
F-69130 **Ecully**
Tel: (78) 33 81 25,
Cable: HEWPACK Eculy
Telex: 31 06 17

Hewlett-Packard France
Agence Régionale
Péricentre de la Cépière
Chemin de la Cépière, 20
F-31300 **Toulouse-Le Mirail**
Tel:(61) 40 11 12
Cable: HEWPACK 51957
Telex: 510957

Hewlett-Packard France
Agence Régionale
Aéroport principal de
Marseille-Marignane
F-13721**Marignane**
Tel: (91) 89 12 36
Cable: HEWPACK MARGN
Telex: 410770

Hewlett-Packard France
Agence Régionale
63, Avenue de Rochester
B.P. 1124
F-35014 **Rennes** Cédex
Tel: (99) 36 33 21
Cable: HEWPACK 74912
Telex: 740912

Hewlett-Packard France
Agence Régionale
74, Allée de la Robertsau
F-67000 **Strasbourg**
Tel: (88) 35 23 20/21
Telex: 890141
Cable: HEWPACK STRBG

Hewlett-Packard France
Agence Régionale
Centre Vauban
201, rue Colbert
Entrée A2
F-59000 **Lille**
Tel: (20) 51 44 14
Telex: 820744

Hewlett-Packard France
Centre d' Affaires Paris-Nord
Bâtiment Ampère
Rue de La Commune de Paris
B.P. 300
F-93153 **Le Blanc Mesnil Cédex**
Tel: (01) 931 88 50

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernerstrasse 117
Postfach 560 140
D-6000 **Frankfurt** 56
Tel: (0611) 50 04-1
Cable: HEWPACKSA Frankfurt
Tel: (06111) 50 04-1
Cable: HEWPACKSA Frankfurt
Telex: 04 13249 hpffmd

Hewlett-Packard GmbH
Technisches Buero Böblingen
Herrenbergerstrasse 110
D-7030 **Böblingen**, Wurttemberg
Tel: (07031) 667-1
Cable: HEPAK Böblingen
Telex: 07265739 bbn

Hewlett-Packard GmbH
Technisches Buero Dusseldorf
Emanuel-Leutze-Str. 1 (Seestern)
D-4000 **Dusseldorf** 11
Tel: (0211) 59711
Telex: 085/86 533 hpdd d

Hewlett-Packard GmbH
Technisches Buero Hamburg
Wendenstrasse 23
D-2000 **Hamburg** 1
Tel: (040) 24 13 93
Cable: HEWPACKSA Hamburg
Telex: 21 63 032 hphh d

Hewlett-Packard GmbH
Technisches Buero Hannover
Am Grossmarkt 6
D-3000 **Hannover-Kleefeld 91**
Tel: (0511) 46 60 01
Telex: 092 3259

Hewlett-Packard GmbH
Werk Groetzingen
Ohmstrasse 6
D-7500 **Karlsruke 41**
Tel: (0721) 59 40 06
Telex: 07-825707

Hewlett-Packard GmbH
Technisches Buero Nuremberg
Neumeyer Str. 90
D-8500 **Nuremberg**
Tel: (0911) 56 30 83/85
Telex: 0623 860

Hewlett-Packard GmbH
Technisches Buero München
Unterhachinger Strasse 28
ISAR Center
D-8012 **Ottobrunn**
Tel: (089) 601 30 61/7
Cable: HEWPACKSA München
Telex: 0524985

Hewlett-Packard GmbH
Technisches Buero Berlin
Keith Strasse 2-4
D-1000 **Berlin** 30
Tel: (030) 24 90 86
Telex: 18 3405 hpbln d

GREECE
Kostas Karayannis
18, Ermou Street
GR-**Athens** 126
Tel: 3237731
Cable: RAKAR Athens
Telex: 21 59 62 rkar gr

Analytical Only
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Marni 17
GR - **Athens** 103
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Cable: INTEKNIKA Athens
Telex: 21 5329 INTE GR

Medical Only
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52 Skoufa Street
GR - **Athens** 135
Tel: 362 6972, 363 3830
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Telex: 21-4693 ETAL GR

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Tel: 1 58 20
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No. 13, Fourteenth St.
Miremad Avenue
P.O. Box 41/2419
IR-**Tehran**
Tel: 851082-7
Telex: 213405 HEWP IR

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Mansoor City
Baghdad
Tel: 551 7827
Telex: 2455 Hepairaq ik
Cable: HEWPACDAD
Baghdad Iraq

IRELAND
Hewlett-Packard Ltd.
King Street Lane
GB-**Winnersh,**Wokingham
Berks, RG11 5AR
Tel: (0734) 78 47 74
Telex: 847178/848179

ITALY
Hewlett-Packard Italiana S.p.A.
Via Amerigo Vespucci 2
Casella postale 3645
I-20100 **Milano**
Tel: (2) 6251 (10 lines)
Cable: HEWPACKIT Milano
Telex: 32046

Hewlett-Packard Italiana S.p.A.
Via Pietro Maroncelli 40
(ang. Via Visentin)
I-35100 **Padova**
Tel: (49) 66 48 88
Telex: 41612 Hewpackı

Medical only
Hewlett-Packard Italiana S.p.A.
Via d'Aghardi, 7
I-56100 **Pisa**
Tel: (050) 2 32 04
Telex: 32046 via Milano

Hewlett-Packard Italiana S.p.A.
Via G. Armellini 10
I-00143 **Roma**
Tel: (06) 54 69 61
Telex: 61514
Cable: HEWPACKIT Roma

Hewlett-Packard Italiana S.p.A.
Corso Giovanni Lanza 94
I-10130 **Torino**
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Medical/Calculators Only
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Via Principe Nicola 43 G/C
I-95126 **Catania**
Tel:(095) 37 05 04

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Via Amerigo Vespucci, 9
I-80142 **Napoli**
Tel: (081) 33 77 11

Hewlett-Packard Italiana S.p.A.
Via E. Masi, 9/B
I-40137 **Bologna**
Tel: (051) 30 78 87

KUWAIT
Al-Khaldiya Trading &
Contracting Co.
P.O. Box 830
Kuwait
Tel: 42 49 10
Cable: VISCOUNT

LUXEMBURG
Hewlett-Packard Benelux
S.A./N.V.
Avenue du Col-Vert, 1,
(Groenkraaglaan)
B-1170 **Brussels**
Tel: (02) 672 22 40
Cable: PALOBEN Brussels
Telex: 23 494

MOROCCO
Gerep
190, Blvd. Brahim Roudani
Casablanca
Tel: 25-16-76/25-90-99
Cable: Gerep-Casa
Telex: 23739

NETHERLANDS
Hewlett-Packard Benelux N.V.
Van Heuven Goedhartlaan 121
P.O. Box 667
NL-1134 **Amstelveen**
Tel: (020) 47 20 21
Cable: PALOBEN Amsterdam
Telex: 13 216 hepa nl

NORWAY
Hewlett-Packard Norge A/S
Nesveien 13
Box 149
N-1344 **Haslum**
Tel: (02) 53 83 60
Telex: 16621 hpnas n

POLAND
Biuro Informacji Technicznej
Hewlett-Packard
U1 Stawki 2, 6P
00-950**Warszawa**
Tel: 395962/395187
Telex: 81 24 53 hepa pl

UNIPAN
Zaklad Doswiadczalny
Budowy Aparatury Naukowej
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Telex: 81 46 48

Zaklady Naprawcze Sprzetu
Medycznego
Plac Komuny Paryskiej 6
90-007 **Lodz**
Tel: 334-41, 337-83

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Telectra-Empresa Técnica de
Equipamentos Eléctricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-**Lisbon** 1
Tel: (19) 68 60 72
Cable: TELECTRA Lisbon
Telex: 12598

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S.a.r.l.
Av A.A de Aguiar 138
P.O. Box 2761
P - **Lisbon**
Tel: (19) 53 21 31/7
Cable: INTERCAMBIO Lisbon

RUMANIA
Hewlett-Packard Reprezentanta
Bd.N. Balcescu 16
Bucharest
Tel: 158023/138885
Telex: 10440

I.I.R.U.C.
Intreprinderea Pentru
Intretinerea
Si Repararea Utilajelor de Calcul
B-dul prof. Dimitrie Pompei 6
Bucharest-Sectorul 2
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Telex: 11716

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